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Decolonizing the Map: Indigenous Maps and GIS

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DECOLONIZING THE MAP: INDIGENOUS MAPS AND GIS

By

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This thesis has been examined and approved by the following members of the student's committee.

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ABSTRACT

An abstract for the thesis of Henry Beimers for the Master of Science in Geography at Minnesota State University, Mankato, Minnesota. 2021.

Title: Decolonizing the Map: Indigenous Maps and GIS

Indigenous mapping practices have yet to be widely considered by geographers outside of a historical context. In this paper I critique the geographic research paradigm through the lens of settler colonial and critical cartographic theory. I present evidence for the value of Indigenous mapping practices through a historical-critical GIS analysis of two Indigenous maps, and a creation of a story map to present those results. Finally, I suggest future routes to integrate digital mapping and Indigenous mapping practices, for pedagogy, and for preserving cultural resources, language, land, and traditional Indigenous knowledge.

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INTRODUCTION

Maps made by Indigenous peoples are increasingly common, particularly as Tribal entities have embraced Geographical Information Systems (GIS) as a means for managing and representing their natural and cultural resources. Maps of Indigenous lands, land use, communal tenure, cultural and natural resources, and maps that remap colonial geographies from native perspectives are important because they are assertions of Indigenous sovereignty. These maps are often made out of necessity, in response to or in conjunction with colonial mapping.

Traditionally, if Indigenous peoples were not involved in the mapping process, then it is possible that when they did appear on a map, such representations were not accurate or to their liking. This is the case today as it was centuries ago. Maps are an important aspect of Indigenous territorial rights. It was Indigenous mapping that led to the creation of the Inuit-governed territory of Nunavut in the 1970s, restored the Grande Ronde Reservation, and was instrumental in the *United States v. Sioux Nation of Indians* supreme court ruling (Camhi et al. 2020; Meisel et al. 2021; Bryan & Wood 2015). Through the practice of mapping, Indigenous peoples have developed their own mapping traditions and geographic theories. The need to reconcile traditional knowledge and relationships to the land with modern geospatial data is where this mapping presently sits. Indeed, even outside of Indigenous communities there is a significant engagement in recent years with mapping non-physical worlds and other spatial knowledges which are important but are difficult to place in Euclidean space (Rost 2016; Bryan & Wood 2015).

Geographers as scholars are uniquely positioned to aid in this work, but not on their own. Not only do we need to have a new understanding of mapping, but a new understanding of space itself (Bryan & Wood 2015). Geographers study Earth, its land, the spatial aspects of human activities, and how space is visualized, and are always developing new theories of space. In this case, a good way to practice innovative geography is to learn from Indigenous peoples. This means adding or integrating Indigenous research methods and Indigenous knowledge into the geographic research paradigm. Although decolonial theory could be engaged within the context of English, history, American Indian studies, or anthropology, the central value of 'land' in colonization and decolonization makes it inherently geographic.

There is a small but significant body of geographers practicing decolonial methods. Doing more than theorization, they are challenging the ways that knowledge is produced. This is often expressed through collaboration with Indigenous peoples and communities (De Leeuw & Hunt 2018; IPSG 2010). These practices involve methods such as participatory research, auto-ethnography, and digital and oral storytelling (De Leeuw & Hunt 2018; Sloan Morgan et al. 2014). Other research may include mapping Indigenous place names and topologies or teaching Indigenous ontologies and epistemologies. The movement to decolonize geographic research and teaching practices ranges widely in scope, from restoring land to adjusting how geography is taught in the classroom. Some of this research has been highlighted in special issues devoted to the topic in journals such as *Geographic Research* (Volume 45, Issue 2, 2007); *Cultural*

Geographies (Volume 16, Issue 2, 2009); *Area* (Volume 49, Issue 3, 2017); and *Cartographica* (Volume 55, Number 3, 2020); in addition to dozens of books and other published articles. The conference room is also a recent place where these ideas can be heard. Although for decades geography conferences and journals have promoted critical themes (such as feminist, queer, Marxian, and critical race theories), creating space for settler colonial theory is a relatively recent phenomenon (Stevens et al. 2015; 'Decolonizing Cascadia?' 2014; Johnson et al. 2007; Rose-Redwood et al. 2020). Despite a growing presence of Indigenous voices and ideas in these spaces,

> given the need to fit academic papers into time-limited presentations expressed in PowerPoint slides, Indigeneity is not just an idea. It is not just words on a screen, theorizations, discourse analysis or a series of case studies. Indigeneity is also lived, practiced, and relational. Yet Indigenous knowledge is rarely seen as legitimate on its own terms but must be negotiated in relation to pre-established modes of inquiry. The heterogeneity of Indigenous voices and worldviews can easily become lost in efforts to understand Indigeneity in ways that fix Indigenous knowledge, suppressing its dynamic nature. (Hunt 2014)

Unquestionably, decolonizing geography also requires a radical reworking of qualitative research whereby "ethics becomes method; data become life; landscape becomes author; participants become family" (Coombes et al. 2014). One example is a series of publications written by Sarah Wright, Kate Lloyd, and Sandie Suchet-Pearson, in which they make their study area itself, Bawaka Country, the lead author (Country et al. 2016). This centers the Indigenous concept of land value: whereby living on and with the land, one gains a relationship to that land, and knowledge about it. This kind of work moves in

the direction of unsettling the paradigm of Western ways of thinking (De Leeuw & Hunt 2018).

Even given these recent examples, Indigenous mapping practices and research methods have yet to be engaged with at a wide scale within the discipline of geography outside of a historical-critical context. As such, part of the goal of my paper is to explore how decolonization has the potential to influence geographic research, along with an examination of how digital mapping and Indigenous mapping intersect in that context.

Another goal of this work is to demonstrate that effective decolonization within the discipline of geography can only occur if our own authority as practitioners of a western academic discipline is challenged. While positivist research is construed as apolitical, a decolonial effort necessitates politicizing our position as participants in the settler colonial system. Decolonizing the map is an inherently political process because, in the context of critical cartography, maps are places of contested power (Palmer & Korson 2020). Although there is a large and growing number of Indigenous geographers (see, for instance, Arceño et al. 2020; Hunt 2014; Johnson et al. 2007; Louis 2007; Lucchesi 2020), the majority of geographers in the Anglosphere—including those who work with decolonial theory—are non-indigenous. If we are genuinely concerned about supporting and revitalizing Indigenous communities and knowledges, then we as geographers must become active in incorporating Indigenous mapping projects, to allow tribal entities to make more informed decisions about how their lands are used.

The purpose of this research is to examine how Indigenous mapping practices and research methods can contribute to the decolonization of geographic research. This research involves: (1) a literature review locating geographic research within a critical framework of settler-colonialism and identifying the importance of decolonial research methods; (2) a historical-critical methodology showing how indigenous mapping can be integrated with digital mapping; and (3) a discussion of the routes for further decolonizing geographic research and mapping practices. This paper involves an extensive review of literature pertaining to Indigenous mapping and decolonial research methods along with research engaging those principles, all of which show how Indigenous knowledge and mapping practices can and are being used to reclaim sovereignty and decolonize the map. Questions to be addressed include: What is the disconnect between people who practice geographic research from a Western vs. Indigenous perspective? What is the responsibility of us as geographers to decolonize the map? Most importantly, how can modern cartography and GIS techniques help to map Indigenous land and promote tribal goals such as they pertain to land re-acquisition, reinforcing cultural identity and fostering natural resource sustainability? This paper will present several success stories related to Indigenous mapping projects and will also hopefully encourage other geographers to engage with Indigenous mapping both critically and in practice.

LITERATURE REVIEW

> Let us add a few words about our perception of maps and the way in which cartography becomes a player in its own rights. Unto themselves, maps depict a piece of reality, sustain a record, and even tell or enhance a story. They reveal environmental truth and raise questions about nature and man's past, present and future. And they help identify and define homelands, borders, ecological niches and the like. But maps may also report in error, obscure, overlook, hide, or even falsify evidence in the natural or fabricated environment. As bearers of symbolic information, maps combine elements of art and science and thus are applied products. Their efficacy depends on their purpose and design, as well as on their sources and accuracy; to some extent on their timeliness, and, reasonably so, on the ability of users to interpret the data. The existence of maps does not presuppose their utility. (Cole & Sutton 2014)

Maps are powerful texts. They are scientific, utilitarian, and pieces of artwork all at once. Maps have power through their creation of reality. In the map, the distinctions of class, power, and colonialism are engineered, reified, and legitimized by means of cartographic signs (Harley 1989; Jakle 1987; Bassett 1994). Maps have renamed and disowned land from its Indigenous inhabitants all over the globe. Maps can also tell stories and express power from a tribal perspective, not just that of the colonizers. One of the ways Indigenous groups can maintain and restore ties to their homeland and sovereignty is through mapping, either as a traditional art or by using modern cartographic practices. This literature review is laid out in sections where scholarship is examined relating to (1) critical cartography and current trends in cartographic theory, (2) historical perspectives on Indigenous geography, (3) contemporary mapping and cartography in Indigenous communities, and (4) Indigenous knowledge production. I conclude by placing my research within this theoretical base.

Critical Cartography

Mapping and cartography as a visual form have several routes of creation and evaluation. They can be considered textually, scientifically, or artistically. When encountering maps in everyday life it is easy to think of them as purely scientific, but they merely represent space rather than are space. Because they are constructed through a process of valuation, selection, omission, imagination, and culture, critical cartography provides a theoretical framework through which those assumptions can be examined (McTavish 2010).

> Critical Cartography provides a framework to analyze historical maps in order to derive information about social relationships … Critical Cartography promotes cartographic integrity, responsibility, and advocates social change … Critical Cartography assumes that maps make reality as much as they represent it. (McTavish 2010)

The term critical cartography encompasses a broad scope of research. It mostly focuses on post-structural and post-representational theories of cartography. Azócar et al. (2014) divide cartography into three periods: positivism and empiricism, neopositivism, and postmodernism. They track the development of cartography as a scientific discipline, and how in the last 50 years cartography has gained depth from the addition of perspectives from social theory (such as poststructuralism). According to them, the three major paradigms in cartography in the 20th and 21st centuries are scientific-empirical, critical, and post-representational. Based on the work of Thomas Kuhn (1962), Azócar et al. (2014) defined paradigms as periods of time within a certain field where one worldview/ideology is dominant in guiding research. Whereas the first two paradigms conceptualize maps as truths, either empirically, culturally, or historically, the post-

representational paradigm considers maps as practices, suites of cultural practices, inscriptions, and unstable and complex texts. In addition to Azócar et al., Wilson (2017) provided a valuable critical perspective on GIS as a subset of cartography.

One of the first scholars to critically analyze maps' place in culture and power was Brian Harley. In the 1980s he began to write about maps as tools of political power and their ability to distort reality in the essay *Deconstructing the Map* (1989). He argued that if analysis of maps remains limited to just what the maps show, then a complete historical picture is unattainable, especially in relation to Indian dispossession (McTavish 2010).

Critical cartography involves a close reading of maps, examining them in a historical and cultural context separate from how the cartographer may have intended. In his influential work *Deconstructing the Map* (1989), Harley proposes a method for studying cartography "rooted in social theory rather than in scientific positivism." He argues that social forces have infused maps with power, which is essential to understanding their place in history. Rather than maps being a way to view the world, he sees them from a particularly human, culturally-specific perspective. There is a large and growing body of research which examines how maps from different cultures are unique products of those cultures, and how interactions (often termed 'encounters' (Lewis 1998b; Short 2009; Cole & Sutton 2014; Palmer & Korson 2020)) between colonizers and Indigenous peoples have led to unique and complex maps in the colonial era and beyond (Mundy 2000; Lewis 1998a; Belyea 1992; Rull 2020). Harley also argues for the

distinction between talking about maps and talking about landscapes. All too often we fall into the trap of talking about the map as if we are describing the landscape when we are only talking about a *representation* of the landscape. A representation which involves selection, omission, simplification, classification, symbolization, and hierarchies, none of which actually appear on the landscape (Harley 1989).

Although Harley's promotion of cartographic textualism provides a substantial basis for map criticism, scholars over the past few decades have continued to build upon his ideas. Many critical cartographers now not only view maps as texts, but also consider mapping as a set of performative practices. Harley alludes to this process, stating that

> just as in factories we standardize our manufactured goods, so in our cartographic workshops we standardize our images of the world. Just as in the laboratory we create formulaic understandings of the processes of the physical world, so, too, in the map, nature is reduced to a graphic formula. The power of the map maker was not generally exercised over individuals but over the knowledge of the world made available to people in general. (Harley 1989)

Still, his analysis is limited by his focus on maps-as-artifacts rather than on mapping-as-process, considering that maps are constantly being remade and reevaluated (Rose-Redwood 2015).

So how does critical cartography relate to decolonizing the map? Critical cartography shares many parallels with Indigenous mapping: they both emphasize how states hold power through controlling mapping and place names, and how Indigenous

groups contest that power through renaming and remapping efforts (Tucker & Rose-Redwood 2015).

One example of critical cartography in practice is counter-cartographies. In *This is not an Atlas: A Global Collection of Counter-Cartographies* (2018), the term counter-cartography is used as opposed to mapping, to challenge the implications of the term, recognizing maps as reductionist and reifying of social traditions. Maps are instruments of positivism and technocracy; therefore, the idea of counter-cartography was developed: a collection of traditions from the arts, science, and political activism which challenge the positivist paradigm. Counter-cartographies are intricately linked to Indigenous mapping practices, as described in this excerpt:

> The idea behind Indigenous counter-cartography is as simple as it is good: '*More Indigenous territory has been claimed by maps than by guns* (emphasis added). This assertion has its corollary: more Indigenous territory can be reclaimed and defended by maps than by guns' (Nietschmann 1995: 37). The mapping of Indigenous biographies played a crucial part in the First Nations campaigns for autonomy in the North of the Americas. This was eventually successful: not only did it lead to the establishment of Nunavut, a self-governed Inuit territory of two million square kilometers in northern Canada…Mapping struggles for Indigenous territories and rights are a central chapter in the history of counter-cartography. Even the term "counter-mapping" was coined by Nancy Lee Peluso (1995) working with the Dayak in Indonesia, using maps for (re)claiming their land. (Kollektiv Orangotango+ 2018)

Indigenous counter-cartographies can intersect with GIS technology through participatory GIS research. Participatory GIS (PGIS) is a powerful tool of building spatial knowledge from the ground-up rather than the top-down. It also integrates a wide range of technologies from sketch maps to aerial photography, satellite imagery, and global

positioning system (GPS) data. Christine Dunn (2007) questions to what extent PGIS can be viewed as a "democratization of GIS". She describes how, in recent years, GIS has been used to grant legitimacy to Indigenous geographical knowledge as well as to 'official' spatial data. She argues that although PGIS is a useful tool for building up communities, it often falls into the category of *participation for publication*, in which academics undertake research while leaving little benefit to their subject communities. This is especially true considering the gap between academic journals and accessibility to the general public. She concludes by suggesting that researchers keep in mind that participatory methods did not originate in the academy, but as a way for communities to work towards change (Dunn 2007). This research is important to consider when collaborating with Indigenous groups, because what is the point of engaging populations in academic research if they will not benefit from it in some way?

Indigenous groups have historically been the subject of the western academy rather than equals working towards a shared goal of improvement. There is a risk of using PGIS research to reinforce those historic power dynamics rather than producing lasting change for communities. There is already an established paradigm for this kind of research: high school students from the Navajo Nation used GIS to plan water resources for the community which influenced lasting policy decisions, tribal nations in Oklahoma using spatial analysis to determine the ideal location for police stations, a graduate student using historical and modern maps in conjunction through GIS to help determine the homelands of the Wintu in California, and many more examples (Taylor 2012; McTavish 2010).

Critical cartographers “embrace complexity, move beyond standards, sneak context in (always), and remember that data is flawed (as are we).” These are the lessons Giorgia Lupi teaches in her article *Data Humanism: The Revolution Will be Visualized* (2017). In this article, Lupi argues that the next paradigm in data should be how to make it as human as possible. This means recognizing that data are often imperfect, systems are complex, and that visualizations should always be considered personal expressions. Her philosophy of visualization connects to the post-representational paradigm in cartography: recognizing that data can be scientific, but also subjective (Lupi 2017). “When we look at a map of the world, we can’t see it as it is. We all lay an internal map of the world on top of the geographical one and only see what’s important to us” (Rost 2016). While these maps may not be useful for something like navigation, they are valuable for making us aware of what we are missing in geographic maps. This helps support my argument that maps need not be scientific to be valuable (Rost 2016).

One important topic within critical cartography is the construction of identity through mapping and maps as cultural texts. There are numerous examples of archiving and affirming heritage through mapping. McClay (2014) surveys the meaning of ‘place’ in the culture of the United States, and papers such as Pearce (2008) discuss the interaction between affect, narrative, and sense of place. *Place* is often used by humanistic geographers. Even though it does not have a strict definition, it still is useful as a commonly recognized human sense (Smith et al. 2019; Tuan 1990; Jakle 1987). Sensing of place is a form of cultural activity. It is not biological, imperative, nor a means

to group cohesiveness. It is a commonplace occurrence, and an ordinary way of engaging with one's surroundings and finding them significant. By describing the landscape and communicating about it with others, a sense of place is formed. Sense of place is both a variety and a culling of experience. It hinges on particulars, and because of that, makes ethnographic engagement essential. It is possible to get a sense of place by existing somewhere as an individual, but by speaking it or describing it in other forms of media like art, music, or clothing, its meaning becomes much deeper. Sense of place is gestalt, like a musical chord or a good stew. It is many things combined to make something new which is more than the sum of its parts.

More detailed studies such as Brown (2019) and Briwa & Wyckoff (2020) research how maps define 'place' and serve to identify communities and cultures that build identity through mapping. The idea of building a community around a common place is ubiquitous, and in many Indigenous communities, places are essential to their cosmology and identity (Nabokov 2006; Basso 1996). Though it is difficult to map spiritual space using western techniques, the integration of Indigenous knowledge and traditions in mapping can affirm their identity through their connection to the land can serve as a means of continuing or sustaining their cultural heritage, particularly using new methods such as GIS-based story maps and visualizations for educational purposes. Indeed, GIS-based story maps serve as valuable tool for preserving traditional cultural perspectives that allows Natives, whether Tribal entities or individuals, the ability to meld a worldview based exclusively on tradition or a perspective that contains varying degrees

of "tradition" alongside modern or non-Indigenous worldviews. In either case, story maps serve as a valuable tool, one that was not an option in the pre-digital era.

GIS story maps are web applications that integrate maps and stories that matter. They lie at the intersection of Indigenous knowledge and GIS technology. While mapping is useful as a tool to reclaim land, it is important to examine *how* maps have been used by Indigenous people in North America throughout history and how they can be used in the future for reaffirming their cultural heritage and territory. By critically examining the cartographic colonization of North America, one realizes that Indigenous peoples have always had considerable spatial knowledge, though they did not use or draw maps in the same way as Europeans. While dominant narratives position Europeans as scientifically mapping an 'unexplored continent,' Indigenous peoples wielded considerable power in initial encounters due to their superior knowledge of the land. This knowledge has persisted and when combined with modern GIS and research, Indigenous mapping can prove to be a valuable tool for reclaiming land and sovereignty.

Cartography and Colonial History

> For indigenous peoples, colonization was not just economic and physical exploitation and subjugation. It was also the exploitation and subjugation of our knowledge, our minds, and our very beings. (Geniusz 2009)

Whether European or Indigenous, nations are built on legends and myths. The United States' national narrative ties the Indigenous people to the land as a unified 'wilderness,'

which would eventually be tamed by settlers. State-controlled mapping has been key in this process of dispossession. The process of colonization has confined Indigenous people to the diminished lands (reservations). The spatial construction is not one-way however, considering that Indigenous peoples have a tradition of connection to the land. They have also moderated the effects of containment through storytelling, writing, and sense of place. They continue this resistance today, as colonization continues, and it manifests itself through Indigenous mapping and knowledge.

The theory of Mikal Brotnov Eckstrom and Margaret Jacobs' chapter "Teaching American History as Settler Colonialism" (2015) serves as a base for the idea of the interaction between European colonists and Indigenous peoples in North America in this research. This chapter outlines a framework for high school teachers to teach settler-colonial history in their US history courses. This course would teach that liberty and exclusion go hand in hand in American political tradition. The republican value of freedom of continuous self-rule initially involved the political subordination of marginalized groups: Enslaved people, Native Americans, and women. For example, settlers in the Thirteen Colonies desired to expand to the west across the Appalachians due to the prospect of economic freedom through land-intensive agricultural practices. Wealthy landowners, especially in the South, saw opportunity both in plantation farming of labor- and land-intensive tobacco and cotton plantations in Kentucky, Tennessee, and Alabama (linking the desire for land to the proliferation of slavery), and in land speculation (Ambrose 1997).

However, the British Proclamation Line of 1763 outlawed any settlement in the 'Indian Reserve' region to the west of the Appalachians. This proclamation served to both tighten control over the Indigenous people and the settlers in the colonies. To defend the Proclamation line, London realized that it required a regular standing army supplied and controlled by Britain. To provide for the upkeep and support of this force, the government also decided to impose a stamp act and later a series of taxes on the colonies, so that American settlers would pay for the land policies. This Proclamation (and the resulting taxes) enraged the settlers, who saw the limiting of their freedom to expand into Indigenous territory as the largest threat to their economic and political autonomy (Rana 2010). The settler aim of being free from a distant Parliament in which they had no representation ran counter to any British policy of protecting Indian tribes and their land occupancy zones. Indeed, such actions were anathema to the settlers' perceived liberty to expand westwards. Eventually this inability to expand westwards was one of the reasons leading to the colonists violent uprising as a means to assert their dominance. From a settler-colonial perspective, colonial dispossession initially rested on physical power, and the momentum was maintained through settler greed (specifically the appetite for fee simple land ownership—something European immigrants could not achieve in the Old World). The justification for dispossession lay in the cultural distinction between civilization and savagery, and maps, numbers, law, and geography itself were crucial to the management of the dispossession (Harris 2004).

Tribal Nations in the US have always resisted the diminishment of, and the removal from, their ancestral lands. Many Tribal Governments with the resources to do so actively seek to recover their lost land. One of the trickiest issues for them to tackle in terms of land recovery is land title. The United States was the first country to establish the legal concept of 'aboriginal title' (or 'original Indian title') based on their original occupancy of land, and it is simply established through proven continuous use and occupancy for "a long time" (*Johnson v Mcintosh* 21 U.S. 572 1823).

> Congress may extinguish aboriginal title at any time, as it wishes. It may provide compensation or not, as it wishes. It may provide judicial recourse for the descendants of the native inhabitants of the land, or it may not, as it wishes. But these realities do not detract from the fact that numerous sources (now including the Second Circuit and the Supreme Court in the Oneida case) may have awakened the Congress to at least a political need to address the consequences of the unsettling of white people's title, if not to a moral obligation to deal equitably with those who had exclusive use and occupancy of this land for a long time (Sutton 1985).

So how do tribes go about proving that they continuously used and occupied their lands since time immemorial? Most of the time historical records are used, often ones kept by Euro-Americans. The contradictions inherent in many of these records lead to much difficulty in many of these cases. Archaeological evidence may be used as well, but even so, when would the cutoff date be for time immemorial? Even more difficult is reconciling the differences in the ideas of property ownership held by Euro-Americans and Indigenous peoples. Though land was held communally, it still was not thought of in the same way as fee-simple title. Lewis and Clark had reported in 1805 that the Pawnees, like the neighboring Otoe and Omaha, had "no idea of an exclusive possession of any

country," complicating their ability to prove exclusive occupancy to the Indian Claims Commission in the mid-20th century (Sutton 1985). G. Malcolm Lewis (1998b) argues that "native North Americans differed from Europeans in not having used maps to divide their terrestrial worlds into finite areas comparable to the Europeans' states, territories, townships, and properties." Indigenous groups at the time of encounter often had zones for hunting, habitation, agriculture, seasonal travel, etc., but lacked the fixed boundaries that were the basis for European-style maps (Bernstein 2018). This was taken advantage of by land speculators as well as the US government's treaty agreements (Harris 2004).

There is an important tradition within historical cartography and American history of critically examining the interactions between colonial powers and Indigenous peoples in North America. For much of the past five hundred years there was no critical examination of the way Indigenous peoples in North America conceived of their living space. Even when scholars did consider Indigenous cartography, it focused on the way in which European colonizers depicted them or it focused on how Native cartographic depictions appeared on European maps (Lewis 1998a). The belief in 'scientific progress' makes it so easy to look down on the maps of the past, as well as maps of other non-Western or early cultures, as inferior (Harley 1989). In reality, these maps had completely different rules, purposes, and cultural contexts.

G. Malcom Lewis was one of the first scholars in the 20th century to promote a critical historical study of Indigenous cartographies:

> The ‘maps’ of nonliterate peoples deserve far more attention than they have received to date in at least five contexts. (1) They are important cognitively for what they reveal about a people's spatial structuring and evaluation of the earth's surface. (2) For archeological purposes, they provide evidence upon which to base searches for settlements and other prehistoric sites. (3) They have ethnological significance as well, particularly regarding their roles within the religious, social, and information systems of indigenous peoples. (4) As historical documents, they should be studied for their roles in communications and negotiations between nonliterate native populations and alien whites. Finally (5), their cartographic importance lies in their influence on maps made by whites. (Lewis 1984)

I would add an additional value being to identify tribal homelands for the purpose of tribal sovereignty and reacquisition, as well as the maps’ cartographic value as standalone objects regardless of their relationship to European maps. Though he makes good points, he still considers the *cartographic* value of the maps of nonliterate peoples only as relative to European ones. His conclusions tend towards interpreting Native cartography as mental maps drawn on paper relative to European standards. This theme was further developed by Mitchell (2014) with an emphasis on the types of cartographic techniques such as the use of variable scales, accentuated straight lines, and using cultural importance rather than physical measurements as a means for depicting size of an entity on a drawn map. These Native practices developed entirely independent of European techniques, rather than being a more primitive version of them. Moreover, Belyea (1992) argued that it is more useful to view these historic maps as culturally specific, and to consider how both European *and* Indigenous maps may distort reality, albeit in different ways. Also, one may want to consider how each set of techniques accurately modeled the reality being experienced.

To assume that the transmission of information in oral based cultures is less accurate than that of a written based culture ignores "the possibility that oral methods of communicating and maintaining knowledge can be just as advanced as written ones," writes Wendy Djinn Geniusz (2009). Geniusz adds that those from oral based cultures "say that our language was supposed to be spoken, not written." In a more contemporary example, Canadian Jamie Zeppa (1999) noted that within the context of the oral based culture of eastern Bhutan, Bhutanese people, "tell stories so it can be remembered, it is remembered because it told." By contrast, in Zeppa's native Canada, "we write things down so there is no reason to remember…hence we forget." Consequently, not having a means of visually representing every sound in their language does not make a people 'primitive.' Instead, they simply use a different means of maintaining knowledge. Early American Indian maps need to be viewed as an oral tradition translated to a graphic medium: one which shows the need for multimedia conceptions of geographic knowledge. In another example, early native paintings (maps) of colonial Mexico come alive with animation if one knows how to interpret the native symbology (Rull 2020). If Indigenous geographic knowledge is passed down through stories and experiences, then story maps may be the best representation for that tradition.

There is little evidence of American Indian mapping from before colonization (Lewis 1998a). The fact that nearly all identifiably Indigenous maps made until the 20th century were at the request of Europeans shows that colonization was not only a process of European dispossession of land, but also of minds, bodies, and knowledge, with the

intention of then claiming that knowledge for themselves (Geniusz 2009; Lucchesi 2020). Recent research on this topic by Mundy (2000), Bernstein (2018) and Rull (2020) has complicated this relationship by arguing that the power balance was much more nuanced in the new world. Indigenous communities had complex spatial and territorial interactions with each other and with settlers, and often held *de facto* power over colonizers due to their greater geographic knowledge. In addition, this theory argues that the primary way colonists disenfranchised Indigenous peoples was through exploiting their cultural differences and internal geopolitical realities in relationship to territory and space (Sutton & Yngling 2020; Park 2016; Lee et al. 2016; Bernstein 2018).

Juliana Barr (2011) argues that it was American Indians, not settler states, which had the power to draw borders in early America. Indians had much more power on the fringes of European geographic knowledge. A good example was the Lewis and Clark Expedition of 1804-1806, which owed its success to a combination of Hidatsa, Mandan, and Shoshone knowledge on where to approach and how to cross the Continental Divide separating the Missouri and Columbia River systems, which included Sacagawea's crucial first-hand recollections of the Rocky Mountains and its eastern headwaters region (Ambrose 1997). On the return trip, Nez Perce guides proved mission critical for re-crossing the Bitterroot Range via the Lolo Trail that was covered by as much as seven feet of snow (Ambrose 1997). Without the American Indian knowledge, the Lewis and Clark Expedition probably would have failed. At the minimum, they would have experienced a significant delay. Lewis and Clark are some of the most celebrated

American explorers, but we do not typically stop to think about how they became so famous. Their expedition was intended to map the territories that the United States claimed with the intention of then exploiting and settling and farming that land. There is something inherently colonial about preparing to dispossess and occupy land primarily through mapping it (Camhi et al. 2020).

Returning to Barr (2011), her case study of the Rio Grande region shows that existing boundaries of different native groups' homelands took precedence over those drawn by the Spanish. She argues that by looking at borders from the perspective of Indian groups, English, French, and Spanish, that Indians were far more powerful with regards to territorial control than they are often given credit for (Barr 2011). On the fringes of Euro-American settler territory, social formations and power dynamics operated independently from the imperial power dynamic, often with Europeans relying on Indigenous groups for survival (Witgen 2007). David Bernstein (2018), in his book *How the West was Drawn: Mapping, Indians, and the Construction of the Trans-Mississippi West* argues that the construction of the American West (defined mostly as the Eastern Great Plains) was a synthesis of Native and Euro-American cartographic processes, which reflected encounter and conflict between the two groups. Much like Barr, he argues that their success as smaller groups in the geopolitical axis was due to their brokering of their spatial and territorial knowledge to either larger Native groups or Euro-American groups (Bernstein 2018). In addition, there is not only evidence in the oral tradition of Indigenous spatial knowledge, but there are surviving physical maps,

often made by Native leaders for aiding European expeditions (Steinke 2014; Bernstein 2018).

Rull (2020) has noted the importance ascribed to Indigenous knowledge and the use of Native painters in affirming Spanish land grants and titles to Indigenous peoples and Spanish settlers in the Valley of Mexico following the Spanish conquest, circa 1520-1560. Indeed, Spanish officials actively sought such Native knowledge pursuant to Royal directives, and certain orders of the Catholic church also employed Native painters and sought to record local geographic knowledge (Rull 2020).

Indigenous maps of have also been used in legal proceedings over land claims for centuries (Rull 2020). In New Spain, the process of granting land to settlers involved a formal petition, an in-person inspection of the boundary, often involving the recording of the survey on a painted map, a questioning of witnesses as to whether the land could be granted without harm to any other party, and finally, a verdict. The land was almost always considered ‘vacant’ unless it was actively being used for farming by the Indigenous inhabitants, regardless of aboriginal title. Such a grant might be resolved in as little as five days, and in any case it often came down to the critical role of Indigenous people in the process: the mapping, questioning, and the usufructuary basis for land ownership were all pre-Columbian practices which the Spanish adopted in order to reallocate the land. These maps and records are still used today in the settlement of land disputes, often between municipalities. The fact that Indigenous-made maps from the colonial era have been held as truth for centuries to validate Indigenous land ownership

speaks to the value of Indigenous maps not just as historical artifacts, but as still-living documents worthy of further practical and academic use.

Indigenous Mapping

> What happens when the poet takes over the cartographer's tools? More interestingly, what happens when the poet is from a group of people who were categorized, colonized, and subjugated in the wake of the colonial moment and implementation of modern conceptions of space? (Goeman 2013)

Indigenous groups worldwide have diverse cultures and conceptions of space. In the past two decades, geographic organizations like the International Geographical Union (IGU) and various cartographic and geographic journals have endeavored to critically examine the value of Indigenous mapping practices in cartographic and geographic research. Even private companies have joined the paradigm of supporting Indigenous mapping. In 2012, Environmental Systems Research Institute (ESRI) published *Tribal GIS: Supporting Native American Decision Making.* This book covers projects and applications ranging from cultural resource management to emergency response. The book also makes a point to discuss ethical and legal issues about data ownership and tribal sovereignty. The results of guides such as *Tribal GIS* should produce not only maps, but also interviews and audio collections as an archive for use by the entire community (Taylor 2012; Tobias 2000). In addition, there are several Indigenous-owned consulting companies practicing and supporting Indigenous mapping, including the *National Tribal Geographic Information Support Center,* Animikii, and the Firelight Group, which hosts the 'Indigenous Mapping Workshop,' the largest geospatial conference in the world

dedicated to Indigenous mapping and Indigenous-led geospatial research (Animikii Indigenous Technology; The Firelight Group; Taylor 2012).

Notable geographic journals have designated space for articles pertaining to decolonization, and several have had special issues on the topic, including those listed at the beginning of the paper. These special issues served as my primary sources for critical Indigenous cartographic theory. These issues discuss numerous valuable topics. The introduction to the special section on Indigenous Spatial Capital from *The Canadian Geographer* (Desbiens et al. 2020) is a succinct literature review. It describes the origin of the idea for the thematic issue on 'Indigenous Spatial Capital' at the 2018 IGU meeting and describes its basis in the critical theory of spatial capital. The authors then describe some of the questions raised at the 2018 IGU conference and the history of the field of Indigenous mapping. This article is a great review of the field of Indigenous mapping (Desbiens et al. 2020) and serves as the primary inspiration for my review. The introduction to the special issue of *Geographic Research* (Johnson et al. 2007) also strongly argues for the value of integrating Indigenous mapping practices in cartographic research. The theme of the issue is "Indigenous Peoples' Knowledges and Rights." The authors summarize the meaning of the term Indigenous and summarize the contents of the special issue (Johnson et al. 2007). Within these issues are also a plethora of informative articles. Articles from the 2007 and 2020 special editions of *Geographical Research* and *The Canadian Geographer* cover diverse topics such as attempts to connect commonalities between Indigenous knowledge systems with the intention of promoting

ethical research practices (Louis 2007), and the potential for online cartography to be decolonial (McGurk & Caquard 2020).

G. Malcolm Lewis produced a comprehensive work on the Indigenous North American cartographic tradition within the larger ongoing series, the *History of Cartography* (1998a). In it he examines topics ranging from the history of word for *map* in various Indigenous languages, to cosmological maps, to changes in American Indian mapping techniques over the course of centuries. While his work covers nearly the whole spatial and temporal scope of mapping in Indigenous North America at the time of publication, in the two decades since, the use of digital mapping by Indigenous peoples has warranted further research on the subject.

One highly effective tool in contemporary Indigenous mapping is GIS software. Along with data ownership and sovereignty, the ability to accurately map, analyze, and present Indian land ownership data gives tribes an incredible opportunity to map their historical allotments. These rights have been the subject of much scholarship in the past few decades, as well as the influential class-action lawsuit *Cobell v. Salazar (*573 F. 3d 808, 809). In this case Eloise Cobell, a member of the Blackfeet Nation in northern Montana, brought a lawsuit against the Department of Interior (DOI) asking for an accurate accounting of individual Indian moneys generated by leasing and extraction of resources such as gas and oil from individual allotment lands. The DOI was unable to provide any accounting and was required to award $3.4 billion to the plaintiffs in a huge victory for the tribal landowners. The case exemplified the urgent need for tribes to be the

stewards of their own lands and the data and maps about those lands rather than the federal government. Many organizations are already doing the important work of providing that data to tribes, including the "Indian Land Tenure Foundation, Village Earth, Indian Agriculture Council, and Native American Agriculture Fund" (Meisel et al. 2021).

Digital allotment mapping exemplifies the ability of GIS to be a tool for Indigenous mapping. It gives the ability to visualize historical data and explore how allotment was carried out. Meisel et al. (2021) developed a GIS tool to generate

> complete and accurately sized and shaped GIS data of nearly all Indian allotments down to the finest scale. These GIS methods and techniques are repeatable and re-creatable in other GIS software; however, it was designed to be used in tribal offices on the reservation where ESRI's ArcGIS is the standard software. This method is intended specifically to automate the process of mapping historical allotments on Indian reservations, but it can also be used by anyone wanting to map land property descriptions recorded in PLSS format. These tools are explained, and preliminary allotment datasets are open-source and will be available at **www.haskellgeography.com.** (Meisel et al. 2021)

Importantly, Meisel et al. recognize the importance of making these tools free and open source, as well as providing a lasting benefit to tribal communities. Though this process is limited as being not fully rethinking geography in an Indigenous worldview, it remains a major step in the continuous process of decolonizing the map.

While there are a number of Indigenous critical cartographers, the majority of Indigenous cartographers use mapping much more pragmatically (Eades 2015). GIS has become ubiquitous in tribal government offices for resource management and planning. It

is a powerful tool with which tribes are already keeping track of cultural resources through the creation of data, and as a teaching tool. It is useful as a database management and analysis system for cultural resources that are identified through research, elder's stories, and community engagement. GIS can also be useful for displaying historical data as a teaching tool for tribal communities and non-Indigenous people, as well as in schools from the primary to post-secondary levels.

Communities which create Indigenous story maps are engaging in a practice that Palmer & Korson (2020) refer to as 'Indigitization'. Indigitization describes a loose system of Indigenous, scientific, and technological knowledge which is ever-changing (Palmer & Korson 2020). If it is true that maps do not only serve to reinforce state power, but also Indigenous power, as Tribes comprise legal entities pursuant to the *Indian Reorganization Act of 1934 (48 Statutes at Large 984)*, then there is hope that story mapping using digital software and the Internet as a platform can be an effective way to promote the adoption of Indigenous mapping practices. Indigenous story mapping promotes Indigenous voices and stories in a creative way because it goes beyond traditional colonial mapping practices. For example, some communities have already been using story maps to tell histories, investigate treaty boundaries, research toponomies, explore public health issues, climate justice, etc. (ESRI Tribal Story Map Challenge), and they have only just begun to explore all the potential possibilities.

Chapin et al. (2005) raised a number of questions about Indigenous mapping as it relates to GIS:

> How, for example, should the ownership of information, data privacy, and access and exclusion be handled? What are the risks of stirring up latent conflicts with mapping, such as when boundaries are drawn through areas of overlap? What measures need to be taken to avoid further stratifying communities with the introduction of mapping technologies? Is it possible to employ the new technologies to preserve traditional knowledge, or do they serve to disfigure it with Western patterns of thought? And perhaps most importantly, what can be done to help indigenous peoples adapt to and accommodate the wave of electronic technologies that are about to inundate them in even the most remote corners of the earth? (Chapin et al. 2005)

Each of these questions can only be answered through real-world practice, and several of them already have. One that should be obvious, for example, is how ownership of information should be handled. At least in the United States, any information or data produced by Indigenous peoples should be theirs to decide what to do with, with regards to tribal sovereignty. This could include GIS data about natural resources, sacred sites, or treaty boundaries.

Carl M. Sack, a faculty member at the Fond du Lac Tribal and Community College, discusses how GIS education can benefit Indigenous communities. In his article "Using GIS to Develop a Career Pathway for Tribal College Students: Journal of American Indian Higher Education," he discusses the college's GIS program, its challenges, and successes along with potential future directions. The program is structured to prepare students for a career in STEM; a GIS-STEM pipeline, as it were. While it has been traditionally difficult to interest Native students in STEM fields, the author sees GIS as a promising entry to STEM careers or graduate studies. Sack shows a growing interest over the last several years primarily fueled by funded internships and

work study positions as well as the opportunities for research and careers with GIS. Students are primarily motivated by an internship program with NASA, as well as work-study position, which "give students real-world experience using GIS to further the natural resource management goals of the Fond du Lac Band" (Sack 2020). Sack finds that students are most motivated to pursue GIS by real-world opportunities which address local needs; a finding which is corroborated by other examples, such a recent project to map water resources by high school students on the Navajo Reservation (Taylor 2012). This model could be used by other tribal institutions for promoting GIS education, and therefore training users within their communities to manage tribal resources more independently and effectively.

Toponymy is another interesting case in relation to decolonizing the map. One of the most subtle ways in which land was dispossessed was through naming. Naming itself is performative. The more often a certain place is called a name, the more valid the name becomes. With naming, repetition legitimizes. Indigenous toponyms are intermixed with European ones all over the United States, including in Minnesota, where the name comes from the Dakota Sioux word *mní sóta*, which is often translated as *cloudy water*. Whether or not it is commonly acknowledged, maps of Minnesota are hybrid language constructs. Each name has meaning inscribed into it. Not only were geographic locations like lakes, rivers, and mountains renamed, but often names were given to swaths of land which had no name to Indigenous peoples. Another example is the origin of the name 'Canada.' When French explorers asked Iroquoian-speaking people what the land they were in was

called, they responded with the word *kanata* (village), because they had no name for the larger country as a whole. At the same time:

> The question is really what do colonizers call the place where the river current begins to quicken? Or where the migratory birds land in Spring? Or where that rock is shaped like an ancestor? The answer is nothing. They have no name because they do not have a relationship with the land … The names that appear on maps represent the big places, not the small ones. The big places are defined by and thus named by colonizers, but they are no less Indigenous land. (Why Some Places Don't Have Names 2020)

The naming of big places is an example of toponymic rescaling. A modern counterexample of toponymic rescaling is the Salish Sea, the body of water straddling the US-Canada border on the Pacific coast. The name 'Salish Sea' was only approved by the highest Board of Geographical Names in the US and Canada in 2009 and 2010, respectively. The requirement for the name change were that the name Salish Sea needed to have demonstrated regular usage, and that the sea constitute a singular bioregion. One complication is that although the name 'Salish' refers to the Indigenous peoples who lived along the coast of the sea since time immemorial, they had never referred to the body of water by such a name. Compared to efforts by Indigenous people to reclaim placenames (such as in Aotearoa, or Denali), how does it fit into the decolonial or anticolonial project considering the name is both recent, and a non-Indigenous invention? Such a name runs the risk of merely romanticizing Indigenous culture while effectively providing zero actual exchange of power to Indigenous people. Fortunately, the name has garnered much (though not unanimous) support from Coast Salish leaders (Tucker & Rose-Redwood 2015). On the positive side, the name *Salish Sea* still recognizes the

presence of the Salish, rather than erasure by omission of Salish toponyms. Still, the fact that the name was changed by the respective geographic boards means that the state still maintains its monopoly over naming.

> Toponymic reclamation involves not only the inclusion of Indigenous place names on existing colonialist–statist maps but also the making of new maps altogether, or some combination thereof. Indigenous-led or informed cartographic projects aimed at recovering place names stretch back at least as far as a 1915 Blackfeet delegation that asked the US Congress to re-establish Blackfeet names within Glacier National Park in Montana. When ignored, they went on to publish a book describing the meanings of over 300 Blackfeet and Kootenai place names. Website portals such as The Decolonial Atlas (https://decolonialatlas.wordpress.com), Native-Land.ca, and the *High Country News*'s interactive mapping of "Land-Grab Universities" (https://www.landgrabu.org) have also made substantive contributions to Indigenous mapping and decolonial cartography more generally. (Rose-Redwood et al. 2020)

These are just a few of the examples in which Indigenous mapping decolonizes, whether through toponymic reclamation, story mapping, cartographic education, GIS resource management, or allotment mapping.

Indigenous Knowledge Production

> Knowledge is performative. In the act of producing knowledge we create space. The primary mode of such activity is hodological; it is movement through space, following and simultaneously creating trails or paths through tagging and making connections. Our trails are reinforced or erased forming complex distributed systems as we interact with other people and our environment. These networks of connections are emergent. They vary with local, cultural and historical contingencies and, in themselves, they are a form of mapping. (Turnbull 2007)

> The stories cannot be separated from geographical location, from actual physical places within the land. … And the stories are so much a part of these places that it is almost impossible for future generations to lose the stories because there are so many imposing geological elements. … you cannot live in that land without asking or looking at or noticing a boulder or rock. And there's always a story. (Silko 1981)

> For indigenous individuals who have been colonized, the thought that their people's language and knowledge could produce anything of equal or greater value than those produced by non-natives seems preposterous. For the colonizer's view of indigenous cultures is of something "primitive," "simplistic," and far inferior to the great knowledge and breakthroughs made by non-native civilizations. This belief works to the benefit of the colonizers, for when the colonized are made to see that their languages and knowledge are of no value, they are far more willing to part with those things. They stop using them. They forget them. They do not teach them to their children. Without languages and knowledge that are different from those of the colonizers, indigenous peoples are easier to assimilate and absorb within the dominant society. Once they are members of the dominant society, indigenous peoples are less likely to see themselves as distinct peoples and less likely to fight for their rights as sovereign nations (Geniusz 2009)

There is this idea that science is purely rational and immune from culture, when the way science is practiced to today is a direct product of Western European culture. One major step in decolonizing cartography is recognizing that science is a product of its European roots, and that causes it to have an inherent colonial lens (Taylor 2019). For cartography this is especially important to note since maps are so often construed as unbiased and often represent elements of human culture. Although this sentiment has been expressed for decades by various scholars of cartography (Harley & Woodward 1987), it is not often noted about maps outside of the context of critical cartography. Indigenous

epistemologies are the critical philosophy behind Indigenous cartography and are essential to understand how processes to decolonize the map will succeed.

One thing that decolonial geography does is challenge the paradigm of Western science. Indigenous science is just as valid as a method of knowledge production, but it is not often recognized as such by governments or academic institutions (Taylor 2019). Despite Indigenous science not having much recognition in the academy there are many similarities with Western science: observation, testing, and communication of the knowledge gleaned (Deloria Jr. 1995). These are things that people do, and have always done, especially Indigenous peoples. The method of transmission is simply different: Knowledge is shared with the community and future generations through stories and oral history. In addition, Indigenous culture sees this knowledge as tied to the people who discover it, whereas in Western science knowledge is something that is developed through a strict and inorganic process. To Indigenous scientists, this sense of connectedness fosters community built around traditional knowledge (Taylor 2019). In contrast to Taylor, Annita Hetoevėhotohke'e Lucchesi suggests that:

> This argument that Indigenous cultures are inherently scientific does not work from an understanding of "science" as a standard to strive to attain, nor does it presume that Western practices understood as "science" meet that hypothetical standard. Likewise, this argument is not about defending the validity of Indigenous epistemologies by comparing them to Western practices. Instead, it seeks to position Indigenous practices as science in their own right, without a need for comparison. Indigenous science, and all the culturally specific variations of epistemologies and practices within it, does not need to prove itself (and certainly Western science never had to do so) or be measured or quantified; it simply needs to be acknowledged as valid and made space for. (Lucchesi 2020)

This relates back to the argument that Indigenous maps deserve to be validated in their own right, rather than only in comparison to European-style maps. Lucchesi also calls for a restructuring of institutional research protocols and ethics to better account for Indigenous ways of knowing. She suggests best practices for how better understanding of Indigenous protocols and sovereignty can help non-Indigenous researchers do scientific research which actually benefits the communities involved in that research.

> Looking to Indigenous epistemologies for ways to get beyond the ontological limits of what is legible as western scholarship, a number of Indigenous scholars have pointed to stories, art, and metaphor as important transmitters of Indigenous knowledge. Stories and storytelling are widely acknowledged as culturally nuanced ways of knowing, produced within networks of relational meaning-making. (Hunt 2014)

This idea of stories, art, and metaphor acting as valid transmitters of knowledge, one sees the value in story maps. The integration of a representation of land along with the stories, art, and metaphor that give it meaning are a key part of decolonization.

> "Indian students, therefore, should consider themselves to be standing in the shoes of their grandparents as metaphysicians. While specific answers are required within the context of Western science, we should remember that these answers are only a temporary statement that is subject to rejection or further refinement at any time. If the non-Indian or even Indian teacher or professor absolutely insists that a certain conclusion is true, remember the grievous sin of the Western mind: misplaced concreteness— the desire to absolutize what are but tenuous conclusions. Students should further remember that while the Indian knowledge is designed to relate to other kinds of experience and knowledge, Western science does not necessarily form a unity. In the reduction of knowledge of phenomena to a sterile, abstract concept, much is lost that cannot be retrieved. By maintaining the personal involvement typical of wise Indian elders, the students should be able to maintain themselves as practical and competent metaphysicians" (Deloria Jr. & Wildcat 2001)

For Native Americans pre-contact, cosmographical stories and relationships are the structure upon which claims upon land are built. One example is the Anishinaabe migration in the 1600s in search of a place where ‘food floats on water’, the result of a legend to establish their homeland (Milgroom). Although American Indian maps did not contain standard distances, they did contain cosmographical concepts such as fundamental axes of the universe and the cardinal directions (Lewis 1998a).

In the West, land is a fee-simple commodity which is easily exchanged and whose purpose is exploitation to earn income. In contrast, Native American communities hold a different relationship to land, tied to ancestral habitation and usage rights, which has a closer relationship to the usufruct concept that underpins appropriation water law in the Western states of the U.S.. The imposition of colonial maps on Indigenous land erased these deeper relationships, instead defining spaces where the landowner had the greatest power. While European maps have historically focused on defining boundaries and establishing property rights, Native American mapping traditions represent this personal relationship to the land. These maps were made on a variety of materials, from sand to rock to animal hides. Much of the time these maps showed not only seasonal migration patterns, but also a deep knowledge of the natural world linked with stories and spiritual practices (Cole and Sutton 2014).

There is a danger in generalizing the Native ‘relationship to the land,’ when considering how Indigenous knowledge is generated. It sounds unchanging, but in reality, it is constantly being reinvented within the context of capitalism and settler colonialism.

It is an idea that is often oversimplified and romanticized and can easily become an easy emotional appeal. However, there is also a breadth of critical and intellectual work that Indigenous peoples do to communicate relationship to land. For example, environmental justice is not something that is inherent in Indigenous communities but has become a generational tradition in response to continued spatial violence. It is also easy to commodify land, and to point to federal Indian law and the courts as the end to all Indigenous land disputes. In the grand scheme of things concepts such as Aboriginal title are recent inventions, and yet another way for the settler state to control the narrative. Ultimately, this control stems from the Indians being classed as vanquished nations with their sovereignty dependent upon the U.S. Congress, although they retain the right to occupy land (*Johnson v McIntosh* 21 U.S. 572 1823). Nonetheless, Indigenous people's stories and relationships are far older than any colonial government, and they continue to maintain them within their communities in spite of colonization. (Goeman 2013)

Where does the importance of 'relationship to land' leave the urban Indigenous population? Over two-thirds of the US American Indian population lived in urban areas according to the 2010 Federal Census. The Indigenous presence in urban areas is more erased than anywhere else, as the ties to a sovereign tribal government often do not exist. Though Native urban communities are often able to maintain traditions where they live, access to land-based communities is essential (Coulthard 2014). Bringing urban and reservation-based communities together through solidarity is part of the decolonial process which can strengthen Indigenous communities. Indigenous mapping and bringing

Indigenous knowledge to urban studies helps. Creative projects as well as story maps are prime tools to use in such a project.

> Even though we can translate the realities of the Indian social world into concepts familiar to us from the Western scientific context, such as space, time, and energy, we must surrender most of the meaning in the Indian world when we do so. The Indian world can be said to consist of two basic experiential dimensions that, taken together, provided a sufficient means of making sense of the world. These two concepts were place and power, the latter perhaps better defined as spiritual power or life force. Familiarity with the personality of objects and entities of the natural world enabled Indians to discern immediately where each living being had its proper place and what kinds of experiences that place allowed, encouraged, and suggested. And knowing places enabled people to relate to the living entities inhabiting it. (Deloria Jr. & Wildcat 2001)

These ideas—relationship, place, and power—show how natural it is to consider the adoption of an Indigenous methodology for geographic and cartographic research.

Indigenous knowledge production is much more fluid and relational than Western knowledge production. It is based on relationships, and above all, relationships to the land. Indigenous groups in the US and Canada have been forced from their historical landscape and placed on reservations, limiting that ability to build relationships to the land. Digital mapping is one way to restore that relationship through mapping, research, and land reacquisition.

Considerations for Geographic Researchers

Johnson et al. (2007) in a theme issue on ‘Indigenous Peoples’ Knowledges and Rights’, write that one of their most important purposes is to encourage a “scholarly

collaboration between Indigenous and non-Indigenous scholars" with the hopes that "geographers and geography may become more than an occasional agent in Indigenous communities' struggles." Community-wide approaches to issues facing Indigenous groups based on cultural frameworks have the ability to be highly impactful (Smith 2012). A successful research collaboration between geographers and Indigenous groups might take years to implement, but if it gives the community the resources to continue to benefit, then it will be worthwhile.

With the advent of predominantly digital mapping, Indigenous data sovereignty is an essential aspect of Indigenous mapping research. This term refers to Indigenous peoples' right to their own data about themselves, and the right to determine the accessibility of that data to others. This is one aspect of the right to ownership of knowledge production for and about Indigenous peoples. This right is within the scope of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Article 31, which reads:

> Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions (United Nations).

The *United Nations Declaration on the Rights of Indigenous Peoples* (2007) should serve as a starting point for any research engagement with Indigenous communities. We should

ask ourselves questions like “Whose lands are you on? Which territorial treaties are they part of? To whom are you accountable? Whose stories and histories are privileged? Who are your collaborators? Are waters, rivers, estuaries, streams, seedlings, beavers, and other beings’ part of that change?” (Bélanger 2020).

Another parallel relative to data ownership stems from the Tribes and their possession of a direct relationship with U.S. Government, something no other American ethnic group (other than Eskimos) has ever had. For example, the spatial data used to draft the Tribal Conservation Code on Minnesota’s Red Lake Chippewa Reservation in the 1990s was obtained through a grant from the US EPA that included EPA staffing on the Reservation to aid in the acquisition and digitization of such data (M. D. Mitchell, personal Communication, March 17, 2022).

In Indigenous societies, relationships are a foundation of culture. Just as in Western research practice we cite our references, in Indigenous science it is respectful to name your relationship to those who have contributed their knowledge to you. Whenever the land is described or stories are told about specific places, the speaker always relates it to themselves. These understandings of the land are made credible by the significance of the relationship and the event’s continuing impact on the people who live there (Basso 1996). These reasons are the why it is important that I describe my own relationship to this research as well as my relationship to the land. In addition, custom typically requires that when you visit the communities to which you do not belong, you must first ask permission, offer gifts and support to those whom you are visiting, introduce yourself,

and allow them to determine if you are welcome. This process is in recognition of Indigenous sovereignty. This process is not so different from visiting any other country in the world; first obtaining permission, offer gifts (often in the form of money to those whom you are staying with), and to introduce yourself and why you are visiting. More than anything else the protocols of the community you are working in should be respected and followed (Lucchesi 2020).

Most geographic research related to anticolonialism and decolonization (mine included) practices one or more of these concepts: work to decolonize geographic research methods and describe anticolonial ones, work to critique and decolonize the discipline of geography and us as geographers, and work to decolonize larger systems of settler colonial power, such as governmental institutions (De Leeuw & Hunt 2018). Many scholars extend their reach beyond the discipline alone, into how geography itself is fundamental to Indigenous dispossession in the real world. This in turn leads to a call to give more space to Indigenous peoples, places, and practices in order to decolonize ourselves and our livelihoods. Because of this, many geographers choose to position themselves in relation to settler colonial power, reflecting on the complications of being white while also trying to do good anticolonial or decolonial research (Johnson et al. 2007; De Leeuw & Hunt 2018; Hunt 2014). For Indigenous intellectuals, reconciling their identities as Indigenous *and* as academic scholars is also complicated, but many of these intellectuals are finding creative and innovative ways to synthesize their identities

within their research (Coulthard 2014; Deloria Jr. & Wildcat 2001; Hunt 2014; Geniusz 2009; Louis 2007; Lucchesi 2020).

For the necessity of this thesis, I adhere to a certain standard of institutional ethics. A standard which may have some overlap with, but which is different from, Indigenous ethics (Hayward et al. 2021, Environmental Stewardship Unit, 2009). The standard of institutional research methodology is also different from that of Indigenous science (Hunt 2014). In order to be legitimate, Indigenous geographic knowledge must fit into this recognized form of representation. The limiting of what is considered valid knowledge production to practices established by Euro-American academic institutions ignores a vast body of Indigenous knowledge production (Geniusz 2009; Smith 2012). Considering this precedent, how might geographic research aid in decolonial projects, and include knowledge rooted in Indigenous worldviews? Hunt (2014) suggested that a good place to start is by accepting that knowledge is partial and recognizing that any attempt to place meaning risks missing something. Considering knowledge as a living thing requires doing away with the element of finality. She also recommended stepping away from the idea of 'expertise'; that any scholar can benefit from merely being a witness or listener.

> What are the limits of a project seeking to decolonize geography but absent of Indigenous peoples as experts or theorists? If Indigenous peoples and places continue to be *subjects* within scholarly contributions of settler geographers seeking to decolonize, is any decolonization really being done? What does it mean to read, write, and teach about decolonization absent of significant relationships with Indigenous peoples on whose land our universities are situated? (De Leeuw & Hunt 2018)

Lucchesi (2020) gave several concrete examples of practices which researchers can use when working with Indigenous communities but did not mention how institutions can change their practices, or how geographic research can decolonize its research practices more generally. Some of her recommendations include:

> Do not assume the community you are intending to map does not already have trained cartographers capable of doing the work you intend to do, do not solicit Indigenous people to participate in a mapping project they did not ask for, if you are coming to map any of our stories or knowledge, you have a responsibility to develop the cultural and technical competence to do the work in a respectful way. This should include undergoing the community's IRB/HSR process, sharing the work you intend to do with the tribal council or leadership, gathering gifts to give to those who share their knowledge with you, and developing a data storage and use plan in collaboration with the community. (Lucchesi 2020)

Lucchesi (2020) continues: (1) "Do not assume that GIS or other Western styles of mapping are useful or desirable for a project in collaboration with an Indigenous community. Make those options available, but be open to utilizing their own mapping practices in the project, and be ready to defend those practices as legitimate in academic and political spaces," (2) "Do not expect an academic publication out of any collaboration with an Indigenous community. If this is something that you feel would be helpful to them or the project, let them know, ask for their permission, and offer them the opportunity to be co-authors," and (3) "Create opportunities to help in building the capacity of the community to continue to create their own maps moving forward." One important note that she mentioned is that many tribal communities have their own IRB/HSR process independent of those of academic institutions, and with different requirements (Arceño et al. 2020). The Sisseton Wahpeton Oyate, for example, has a

tribal law that governs all research within the boundaries of the Lake Traverse Reservation. The law includes statues pertaining to permitting, ethics, fees, enforcement, and ownership rights (Sisseton Wahpeton Oyate).

Glen Coulthard (2014), a professor and member of the Yellowknives Dene First Nation, suggested that a rights-based politics of recognition is not enough to decolonize Indigenous communities. Inspired by the work of Frantz Fanon, he suggested they instead practice "a resurgent politics of recognition that seeks to practice decolonial, gender-emancipatory, and economically nonexploitative alternative structures of law and sovereign authority grounded on a critical refashioning of the best of Indigenous legal and political traditions." He stated that this is the only way that Indigenous communities can survive and revitalize while under the control of a settler-colonial state. In other words, Indigenous communities should return to a critical form of self-recognition and self-governance. This practice involves a decolonial relationship to the land, which can be achieved in part through Indigenous mapping.

Decolonizing research also involves a complete restructuring of the philosophy which underlies our understanding of the world. One example of how Indian metaphysics might be understood is as "the realization that the world, and all its possible experiences, constituted a social reality, a fabric of life in which everything had the possibility of intimate knowing relationships because, ultimately, everything was related" (Deloria Jr. & Wildcat 2001). Once again, the concept of relationships undergirds the Indigenous worldview, and all its facets.

Though I have covered some of the considerations that geographers should take into account when collaborating with Indigenous communities, there are many more questions that we can ask ourselves about our research methods. Smith (2012) outlines "25 Indigenous Projects", ranging from *Rights of the People* and *Indigenous Language*, to *Children*, *Sharing*, and *Healing*. Each of these twenty-five projects are individual ways to restore Indigenous culture and self-determination. Though they may be somewhat broad terms, the 25 projects provide a starting point for thinking about what our goals as researchers might be when developing an Indigenous research agenda. Most decolonial mapping projects relate most closely to the *Naming* project, though any number of them could be supplemented through Indigenous mapping.

The study of geography is concerned with the land on earth and the people who live on it. Therefore, it is the responsibility of geographers to know about the history of the land they live on, and the people who live there. For us in the United States, this means understanding that we live on colonized land, and that we must consider how we benefit from the exploitation of that land and its Indigenous inhabitants. How can our departments and research materially support these people who have been disenfranchised at to our benefit? Shifting our perspective so that the end goal is not to publish, but to do good for those communities, is an effort worth pursuing (De Leeuw & Hunt 2018).

Research Framework

This literature review covers a wide range of research examining critical cartography, historical cartography, Indigenous mapping, and knowledge production, and decolonial theory. It is important to consider the wide theoretical framework which inspires this work, and the potential future directions for similar work. The literature review above outlines the need to consider the importance Indigenous mapping and knowledge production to geography, and the methodology below provides a concrete example of one way to engage Indigenous mapping practices

METHODOLOGY

With a firm theoretical background established, we can begin to address the question of how modern cartography and GIS techniques can help to map indigenous land and promote tribal goals. The literature review above outlines examples as they pertain to PGIS, tribal resource management, oral history, etc., but how can *historical* Indigenous maps provide valuable information to tribes whether it be in the form of cultural resources or as evidence for historical residency? Maps made by Indigenous North Americans using Indigenous techniques are well-documented, as are maps which were made by Europeans or Americans using native information (see Lewis 1998a, Lewis 1998b, Warhus 1997, Steinke 2014, Belyea 1992, Thiessen et al. 1979), but they have been rarely considered outside of their historical context. One recent exception was the use of American Indian cartography as a means of explaining mental mapping principles (Mitchell 2014).

In the modern digital era this begs the question: What kind of information can digitization and GIS analysis of these maps yield? Digitization can show the location of historical habitation and cultural sites, elucidate Indigenous peoples' geopolitical claims and worldview throughout history, and enable the presentation of the information within the maps in a clearer way. Sitting Rabbit's map (Figure 1) shows many historical village sites along the Missouri river (circa 1803), but if the map sections were digitally georeferenced, the locations of those villages would be much easier to identify.

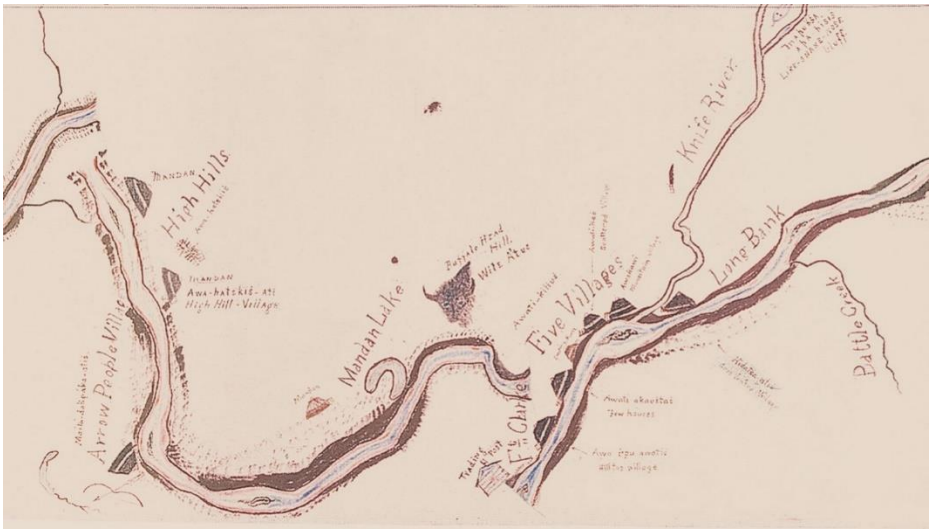

Figure 1: Detail from Sitting Rabbit's Map, 1907 (Sitting Rabbit's Map)

Mary Whelan (2003) provides an excellent blueprint for Indigenous map digitization using the 1837 Ioway Map (Figure 2). She outlines a process of using GIS to georeference the map and identify villages and trails, while documenting a detailed workflow as well as the difficulties involved in translating Indigenous maps to a geographical coordinate system. While my research follows many of the same methods, the goals are slightly different. Rather than identifying cultural features, I aim to show how American Indians used maps diplomatically to establish claims over territory and exercise sovereignty. This is done through the digitization and analysis of two Indigenous maps from the Upper Mississippi valley in the early 1830s. Both maps were made for Indian Agents representing the United States, in order to dispute treaty boundaries. Each map is slightly different in terms of the context of its creation, and its reception by

officials, and by comparing them I aim to show the value of digitizing these maps in understanding Indian geopolitical positions during the period of Indian Removal.

This methodology aims to make a connection between Indigenous mapping and digital mapping practices, and evidence the value of Indigenous mapping principles to geographers for practical purposes. I will show this through (1) presenting practical applications for the digitization of historical Indigenous maps using GIS software and (2) showing an example of how digital story mapping provides a uniquely suited platform for Indigenous mapping.

Figure 2: Ioway Map, 1837 (Map Presented)

Data

The first of the two maps I will be using is an 1833 map with no clear title, but with various notes which read “Indian Map marked with charcoal on the floor of the agency office & hastily tho imperfectly taken from it—”, “A fort on the 2nd fork of the Desmoines or At the fork of Red Cedar may become necessary”, and “Waa paa Koo Ta -

Sioux Map – To be forwarded with this message to the Comm. In Affairs Washington" (Figure 3). I will refer to this map in the rest of this work as "the Wahpekute map," to use the proper name for that band of Dakota people. This map was created by a small group of Sioux for Major Lawrence Taliaferro, Indian Agent at the St. Peter's Agency, then copied by Taliaferro onto paper. In a letter from Taliaferro to the Commissioner of Indian affairs in Washington, Elbert Herring, dated July 5th, 1833, he detailed that the group of Sioux men disputed the treaty line between their territory and that of the Sac and Fox as defined in the treaties of 1825 and 1830 (Taliaferro 1833b).

The second map in this analysis is an 1831 map entitled "Neenaba's Map. line on the Red Cedar Fork 1831", which I will be refer to as "Neenaba's Map" (Figure 4). This map was created by an Ojibwe man named Neenaba for Henry Rowe Schoolcraft in 1831. Schoolcraft, then Indian agent at the Sault Ste. Marie Agency, was traveling from Lake Superior to the Mississippi through Wisconsin on a diplomatic mission to "endeavor to terminate the hostilities between the Chippewas and Sioux" (Schoolcraft 1855). Schoolcraft referred to Neenaba as "a popular war-leader from the Red Cedar fork of Chippewa River" and detailed extensively meetings held with him over the course of several days in early August 1831 (Schoolcraft 1855). The map included in this research was commissioned by Schoolcraft and was made by Neenaba's own hand, the labels translated by "Mr. Johnson" from Schoolcraft's party (Schoolcraft 1855). In his words, Schoolcraft "asked him to draw a map of the lower part of Chippewa River, with all its branches, showing the exact lines as fixed by the treaty at Prairie du Chien, and understood by them" (Schoolcraft 1855). The meetings were meant to resolve the issue of

which side of the line some new mills were built by settlers, as well as murders and raids between the Ojibwe, Sioux, and Menominee. The general study area of the two maps is shown on figure 5.

Both of these maps are curated by the Cartographic and Architectural Branch of the National Archives and Records Administration (NARA) in College Park, Maryland (Record Group 75; Central Map File, 1824-1960). I could not find dimensions for the original maps, although the map drawn in charcoal which Taliaferro copied "was evidently large" (Lewis 1998a). For the purposes of this research, I utilized high-resolution scanned images of both maps provided by NARA on their digital catalog.

In all, I used 36 files to complete the work reported here, 1 project file, 8 geoprocessing files, 8 basemap files, and 20 georeferencing files. Appendix A contains a list of the files as well as the repository of my files for access by the public.

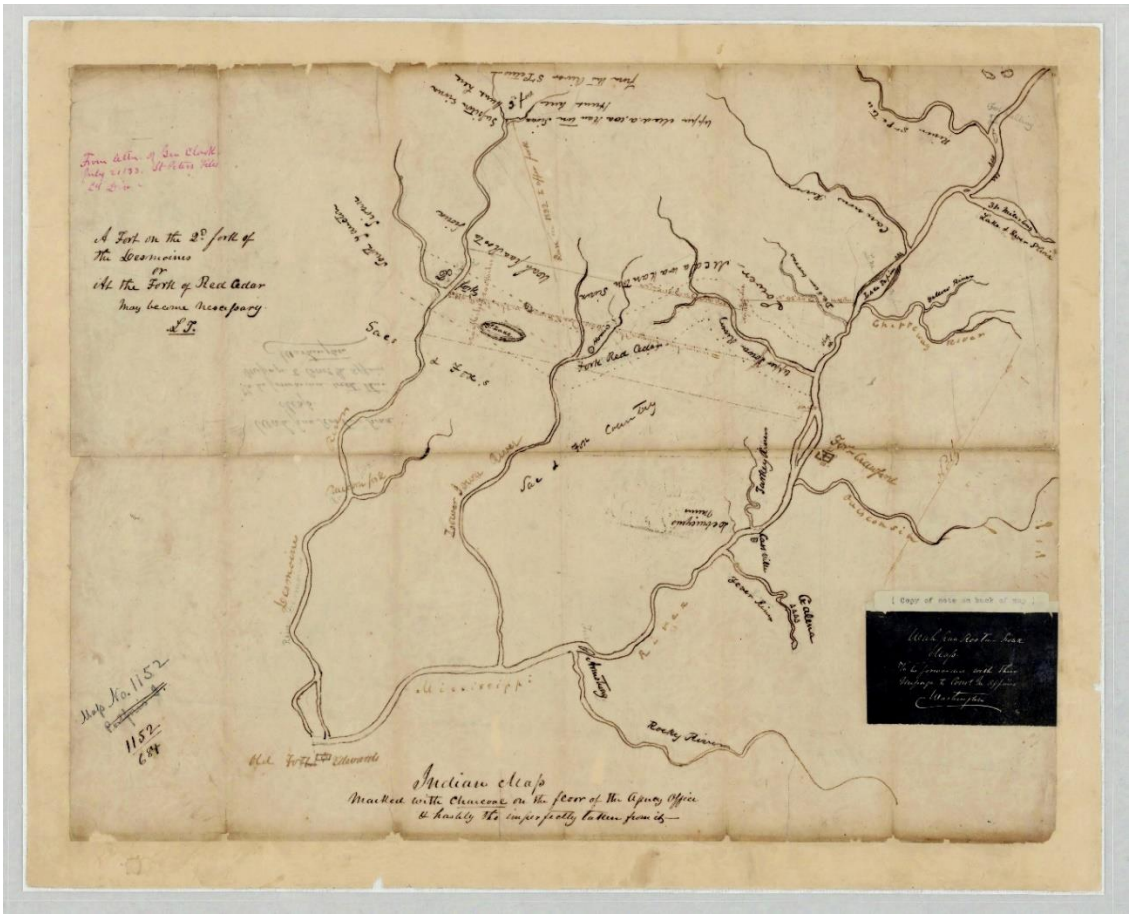

Figure 3: The Wahpekute Map (A Fort on the 2nd fork)

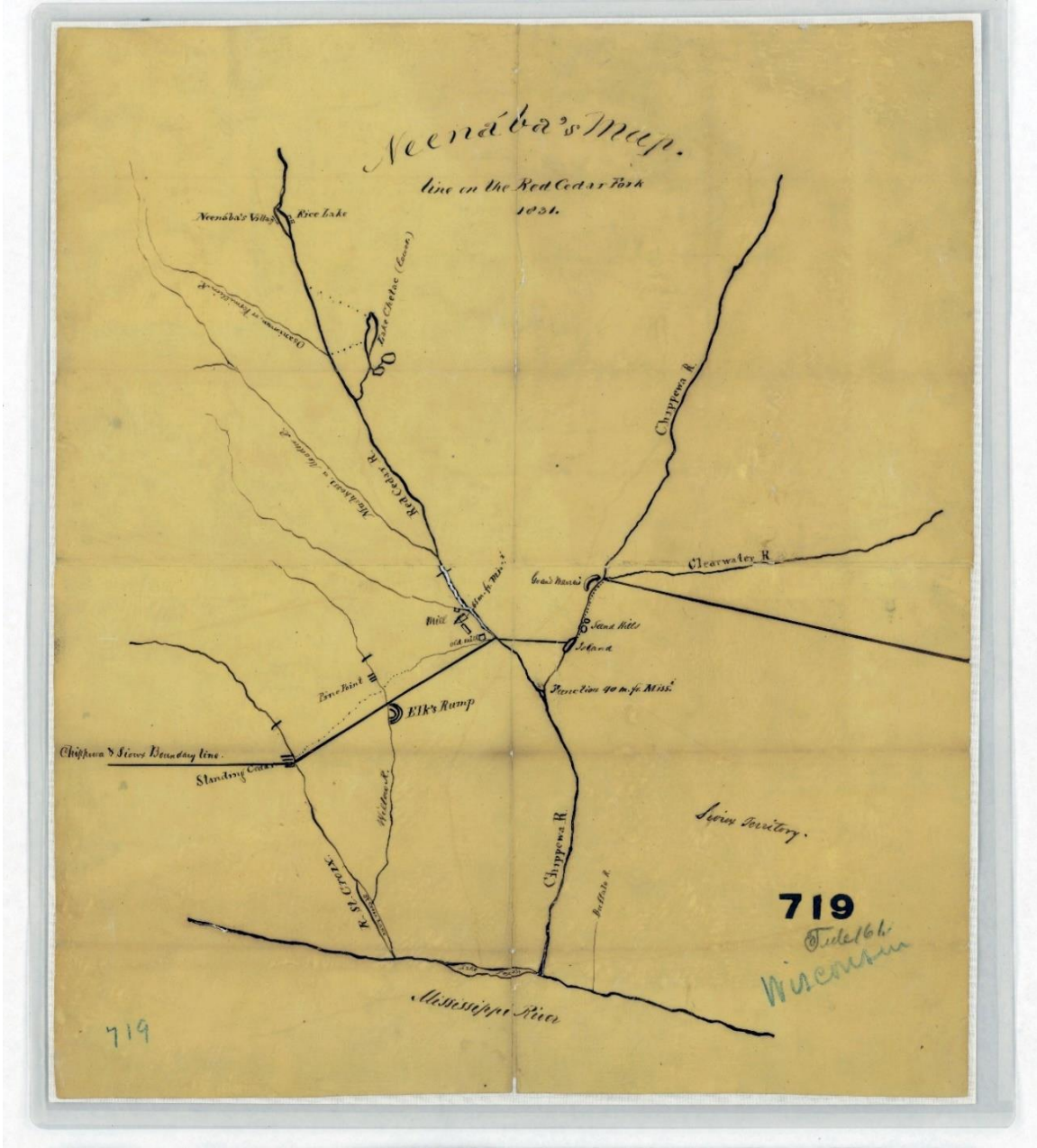

Figure 4: Neenaba's Map (Neenaba's Map)

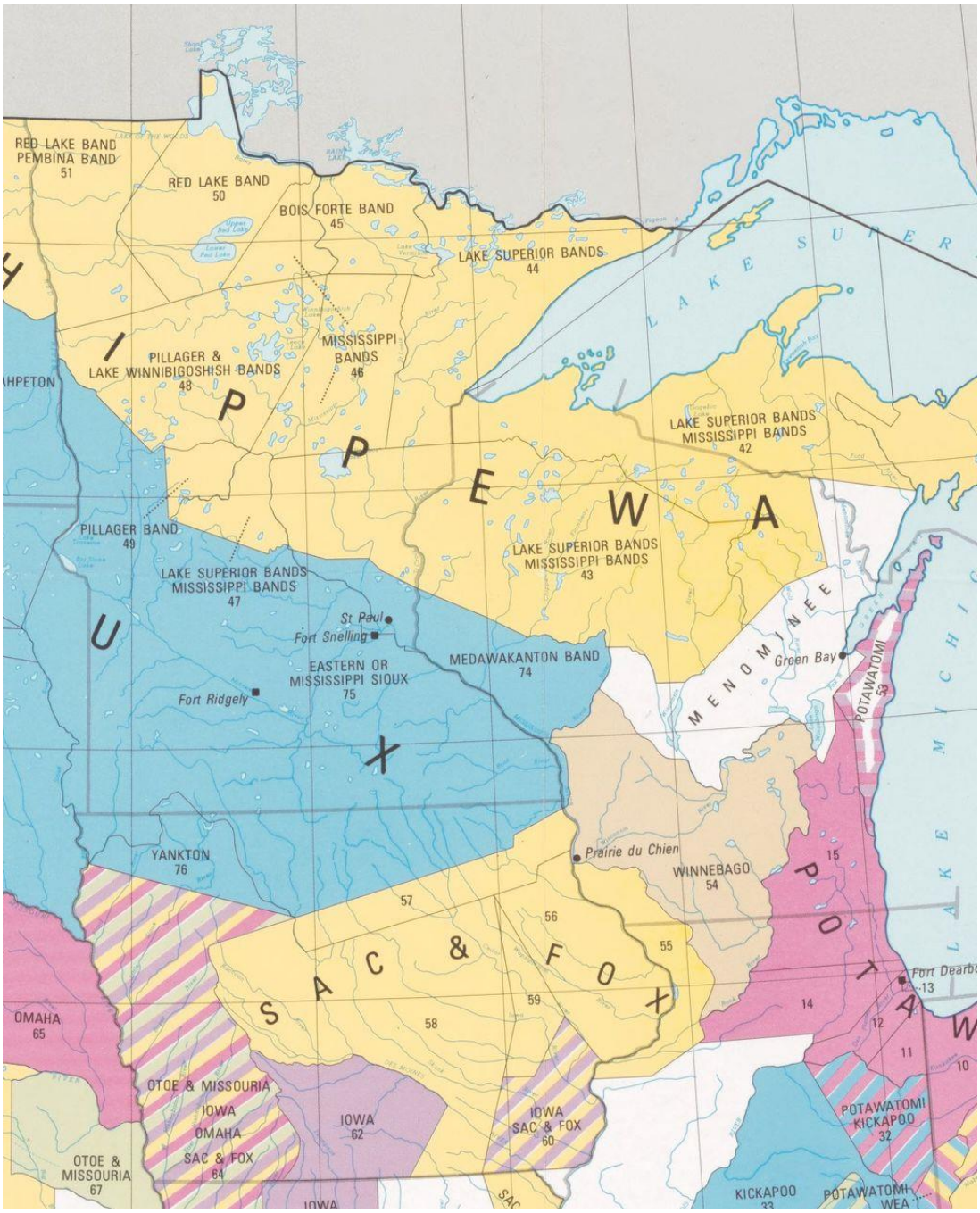

Figure 5: Detail from map of "Indian Claims Judicially Established", published by the Indian Claims Commission, 1978, showing the general study area, as well as the disputed treaty lines between the Chippewa, Sioux, and Sac & Fox (Geological Survey 1978)

Georeferencing

In a general sense, georeferencing is defining the spatial coordinates of a digital image. This image could be an aerial photo, satellite image, or (as in this case) a scanned physical map. For this project, I used ESRI's ArcGIS Pro 2.5 for my GIS software. Georeferencing requires a datum and projection, and I chose to use WGS 84 Web Mercator (EPSG:3857), the standard for web mapping applications. While this might not be the best choice for reducing map distortion, it makes sense for this project given that the results are presented in the format of a web mapping application. The base maps and other geographic data besides the scanned map files were already in Web Mercator. The scanned files (.jpg) had no geographic data before georeferencing, so they are imported, and the bottom left corner is located at 0,0. The georeferencing process defines the scanned image features using known locations on the map and on the earth's surface.

ArcGIS Pro has a georeferencing tab which can be found under the Imagery panel when you select a raster dataset in the Contents. The "Transformation" tab includes several options for georeferencing and rubber-sheeting, and I will compare the accuracy and usefulness of these methods based on their error, as well as visual appeal. I will compare the Similarity Polynomial, First-Order Transformation (Affine), Second-Order Transformation, Third-Order Transformation, Adjust Transformation, Projective Transformation, and Spline Transformation for each of the two maps. Each of these methods have certain pros and cons, and none are absolutely above the rest. The results of these methods will be discussed in the results chapter.

After loading the raster image into ArcGIS Pro, one must “register” the image using ground control points (GCPs), which are points that are known on both the basemap and the georeferenced map which allow it to be aligned. Typically, GCPs should be points which change little over time, such as building corners, street intersections, or mountain peaks. In the case of these two maps there is hardly any detail besides rivers, so hydrologic features were selected. Typically, rivers are not a good option because their courses naturally change so frequently and are affected by damming, but in the case of these two maps there is little besides rivers, so river confluences made the most sense to choose. Although each map also contains lines representing treaty boundaries, I intentionally chose not to use them for control points because part of my analysis compares where the lines were drawn on the Indigenous maps compared to their actual location.

For each map I chose a total of ten control points, most of which consist of river junctions, along with one fort location, and one lake. The registration process entailed clicking a point on the historic map, then clicking the corresponding point on the basemap, creating a GCP. For my registration layer I used the USGS National Map layer which comes built in on ArcGIS Pro. Using the ArcGIS Pro “Auto Apply” option, the map automatically applied the mathematical transformation formula each time I added a point, allowing me to observe the error and changes to the historical maps with each additional point. After I had chosen all of my GCPs, I experimented with each transformation method, which I will explore in the results chapter.

Comparison and Analysis

The Wahpekute Map and Neenaba's Map were mainly be compared stylistically, but also in the accuracy with which they display treaty lines. I hypothesized that in each of the maps the treaty lines are drawn in a way which provides support for the author's claims: in the case of the Wahpekute, they claimed that the surveyed line was not drawn with respect to the terms of the treaty, and for Neenaba, it was about where the line crossed the Red Cedar River "directly below the falls" (Ratified Treaty No. 139). I also considered the historical context for each of these maps, looking at letters, treaties, and related maps, and look at how each map did or did not change the situations of each of their creators.

Digital Story Map Design and Creation

I will present the results of the historical-critical GIS of these two maps using an ArcGIS StoryMap (linked to here and in Appendix A), and here I describe the design process and principles I use. ArcGIS Online StoryMaps is a free service that integrates maps into a webpage along with text, images, audio, and video, with the purpose of contextualizing GIS data. Story Maps operate under the assumption that data is meaningless unless it is contextualized and visualized in a way that makes sense.

When beginning to design this story map, I started by thinking about what I wanted my primary message to be, and to produce a good title page that gave a good first impression of the work. I entitled the story map "Indigenous Maps as Territorial Contestations" with the subtitle "Comparing two digitizes Indigenous maps in a historical

context." This title exemplifies what I believe to be the most interesting takeaway of this methodology: the exploration of these maps' implications and inherent meaning in the context of Indian Removal in the 1830s. For my title image I chose a still of the first page of the Treaty of Prairie du Chien, 1825. When designing the story map layout, the user can select from a number of prebuilt themes, which determines the typefaces, formatting, background color, and heading. I chose to customize my own theme with typefaces and colors of my choosing, along with the MSU, Mankato logo at the top, which links to the MSU, Mankato geography website. I then used the navigation bar to outline my story map using headings. This bar allows you to jump to certain sections from anywhere in the story map. I organized the map by looking at the historical context, examining the Wahpekute Map, examining Neenaba's Map, examining both using GIS, Conclusions, a timeline of events, and a final note on the context of this story map's creation as part of this larger work.

When filling each section, it helped to think of the layout of the story map as though I were telling a story: giving background information, going into the different maps with several types of analysis, then concluding. One of the benefits of Story Maps is the ability to weave together maps, imagery, and other types of media with text more creatively than in a word document. Story maps have much in common with word documents, blogs, and other web pages, but have the ability to be formal or informal in feeling.

For each of the two maps I used a sidecar, which is a format where the text floats across an image or map as you scroll. This allows the images to fill up the entire screen, enabling you to easily highlight different areas of an image or map. It also allows users to explore an image within the larger body without having to scroll through a document to look for the figure. For the GIS Analysis section, I inserted three interactive maps, which are also included in the results section below as still images. The ability to interact with these maps also enables the reader to gain a greater understanding of the information presented by allowing them to explore it on their own. After each interactive map I examined the context of the georeferenced treaty lines compared to the accompanying treaties, letters, and other maps. By including high-resolution images of the letters and treaties quoted, readers are able to also interact with the primary documents firsthand, and users of the story map feel more engaged with the content.

Finally, I included a timeline, which helps to visualize these maps, treaties, letters, and events chronologically. The timeline helps to place this story within the larger context of United States history and connect these documents to real-world events happening concurrently. Overall, designing and publishing a story map is a relatively straightforward process, and enables a wide variety of customizable visualizations, images, maps, and other media to go along with the text. In the following results section, I will discuss the pros and cons of story maps as a way to communicate research and Indigenous mapping.

RESULTS

In this section I present the results of my analyses of the Wahpekute and Neenaba Maps along with accompanying primary sources. These Indigenous maps and their use by officials of the US Government provided a unique look at the diplomacy between American Indians and the Government in the Upper Mississippi Valley during the period of Indian Removal in 1830s. They also express sovereignty in the way that Tribal groups exerted control over boundaries. Although the US government drew up the treaties and surveyed the lines, the Tribal groups took ownership over these boundaries on these maps by expressing their interpretation of the treaty language. Both Schoolcraft and Taliaferro expressed a deep respect for the Native Americans' geographic knowledge, as seen in their letters and reports (see Appendix B). Both agents urged the Commissioner to seriously consider the disputes over the boundary lines, and both suggested the construction of military posts near the areas of conflict (Schoolcraft 1855, A fort near the 2nd fork). Both agents also included these Indigenous maps as evidence for their claims.

To give some historical context: Andrew Jackson had become president in 1829, and the *Indian Removal Act* (4 *Statutes at Large* 411) leading to the Trail of Tears was passed in 1830, completely changing the course of Indian Affairs as practiced by Jackson's predecessor, John Quincy Adams (Saunt 2021). Adams had made gradual assimilation the official policy of the federal government while also expanding the country westward. However, the Jackson administration quickly made removal the official policy and it remained that way until at least 1847 (Saunt 2021). There had been

several recent conflicts between the US and Indigenous groups in the Upper Mississippi Valley, including the Winnebago War of 1827, and the Black Hawk War of 1832. Both of these conflicts ended poorly for the Tribal groups, with the result that they would be forced to move west, as many in the US Government no longer considered it possible for Indigenous peoples and Settlers to live peacefully together (Saunt 2021). Another event of note is the supreme court decision of *Worcester v. Georgia* in 1832, which was important to the establishment of tribal sovereignty.

These two maps were the result of disputes over boundaries created at the treaties of Prairie du Chien in 1825 and 1830. Notably, these treaties were less concerned with acquiring land from Tribal groups than with defining the boundaries between them to preserve peace on the country's Northwestern frontier. Why was the US so concerned with preserving peace between the several Tribal nations in the Upper Mississippi? Defining the boundaries between tribal groups gave the government more direct control over the area, as can be seen in these petitions to the government by Tribal groups. The policy of pacification also made eventual removal and diminishment much easier. The government also likely did not want to spare the expense and losses of sending in the U.S. Army to forcibly remove the Tribes. It is also important to consider that the nature of his assignment at the St. Peter's post meant that Taliaferro was primarily concerned with the well-being of the Sioux, and Schoolcraft's primary duty was the well-being of the Ojibwe. It is also likely that both men had paternalistic views towards their American Indians, considering them their wards, which explicitly follows the intended relationship

between the Tribes and the U.S. Government as stated by Justice Marshall in *Johnson v McIntosh* (21 U.S. 572 1823) and formed a premise for the assimilation policy of former President John Quincy Adams. They were also certainly not without personal bias, Taliaferro and Schoolcraft having respectively married into prominent Dakota and Ojibwe families from the areas around their posts (Britannica; Farber). All of these reasons likely contributed to each of their vehement promotion of the Dakota and Ojibwe stances on the boundary lines: wanting both peace, benefit for the people with whom they had been entrusted, and to be seen as benevolent and tireless advocates.

Both the Wahpekute Map and Neenaba's map express their geopolitical stance in the Upper Mississippi region. Both maps were created for an intended audience of Euro-Americans, which may explain the lack of some cartographic conventions typical on other Indigenous maps. Examining these maps using GIS helps to explain the reasoning behind their choice of conventions.

As stated previously, both of these maps were made in the early 1830s for Indian agents of the US Government. Although we know that Neenaba was the creator of one of the maps, for the one copied by Taliaferro, we only know that it was a group of men from the Wahpekute band of Dakota. Neenaba's map was made upon request by Schoolcraft to illustrate his understanding of the boundary between the Chippewa and Sioux, and the Wahpekute map was made in charcoal on the floor of the St. Peter's agency to communicate the group's understanding of the boundary.

There are many other examples of maps created upon request by Indigenous peoples; notably Too Ne's map for Lewis and Clark, and Sitting Rabbit's map (Lewis 1998a, Steinke 2014, Warhus 1997). In addition, drawing temporary maps on the ground with sticks, charcoal, or in the sand was not an uncommon practice either (Lewis 1998a). Taliaferro noted at the bottom of the map, "Indian Map marked with charcoal on the floor of the agency office & hastily tho imperfectly taken from it—", which was drawn during a visit by several Wahpekute "chiefs and head men" to the St. Peter's Agency sometime shortly before July 5th, 1833 (A Fort at the 2nd fork; Taliaferro 1833b).

The context of Neenaba's map is described here by Henry Rowe Schoolcraft in his report from 1831:

> I asked him whether the saw-mill on the lower part of the Red Cedar, was located on Chippewa lands? He said, Yes. Whether it was built with the consent of the Chippewas? He said, No; it had been built, as it were, by stealth. I asked him if anything had been subsequently given them in acknowledgment of their right to the soil? He said, No; that the only acknowledgment was their getting tobacco to smoke when they visited the mill; that the Sioux claimed it to be on their side of the line, but the Chippewas contended that their line ran to a certain bluff and brook below the mill. I asked him to draw a map of the lower part of Chippewa River, with all its branches, showing the exact lines as fixed by the treaty at Prairie du Chien, and as understood by them…
>
> …The line between the Chippewa and Sioux, as drawn on the MS. map of Neenaba, strikes the rapids on Red Cedar River at a brook and bluff a short distance below the mill. It proceeds thence, across the point of land between that branch of the main Chippewa, to an island in the latter; and thence, up stream, to the mouth of Clearwater River, as called for by the treaty, and from this point to the bluffs of the Mississippi Valley (where it corners on Winnebago land), on Black River, and not to the "mouth" of Black River, as erroneously inserted in the 5th article of the treaty; the Chippewas never having advanced any claims to the

> lands at the mouth of Black River. This map, being drawn by a Chippewa of sense, influence, and respectability, an exact copy of it is herewith forwarded for the use of the Department, as embracing the opinions of the Chippewas on this point. The lines and geographical marks were drawn on paper by Neenaba himself, and the names translated and written down by Mr. Johnston (Schoolcraft 1855).

There is no record of the size of each of these maps, but both are small enough to have been enclosed in an envelope along with letters. However, Lewis (1998a) states that the original floor-drawn Wahpekute map "was evidently large." Both maps prominently feature rivers, with little else. The Wahpekute map includes quite a bit more than the Neenaba Map, however. It has a few lakes and some settlements, including Fort Armstrong, Galena, Fort Crawford, along with a few other unlabeled villages. Interestingly, several symbols are used for forts, villages, and trading houses, with seemingly no pattern. For example, Galena is marked with four triangles while Cassville and Fort Crawford use grids. Fort Armstrong is only a dot on Rock Island, and the trading house at the Red Cedar fork is marked with an encircled point (Figures 6-8). I would think that the symbols have something to do with the population, which would make sense for Galena, being one of the largest towns in the area in the early 1830s. The different symbols may also denote distinct functions of the settlements.

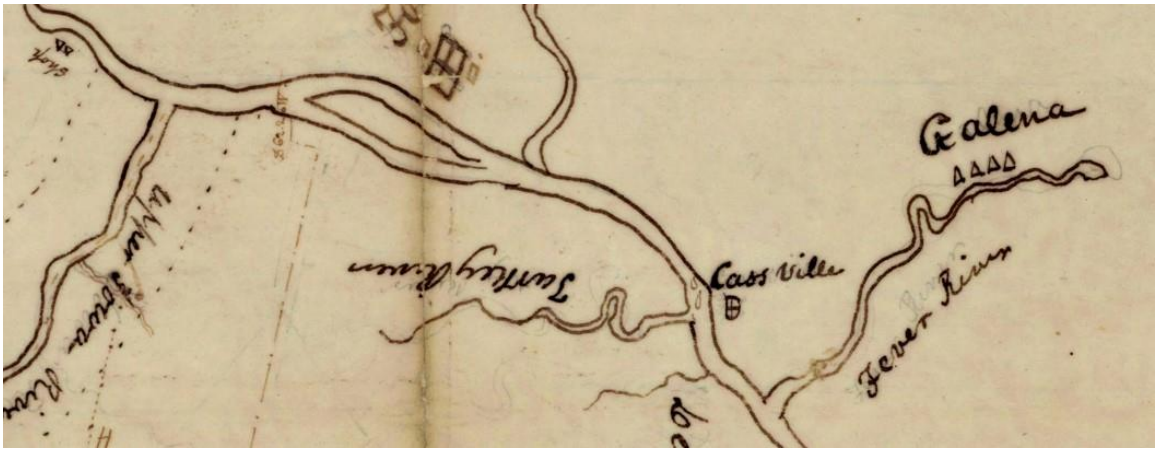

Figure 6: Detail from Wahpekute Map. Galena marked with four triangles, Cassville with a small grid, and "Shop" in the upper left with two triangles (somewhere between the Upper Iowa and Whitewater Rivers)

Figure 7: Detail from Wahpekute map. "House" marked with a target at the fork of the Red Cedar River

Figure 8: Detail of Wahpekute Map showing settlement symbology. It is unclear whether these are American or Native settlements, although it is likely the one at the head of Lake Pepin is Red Wing

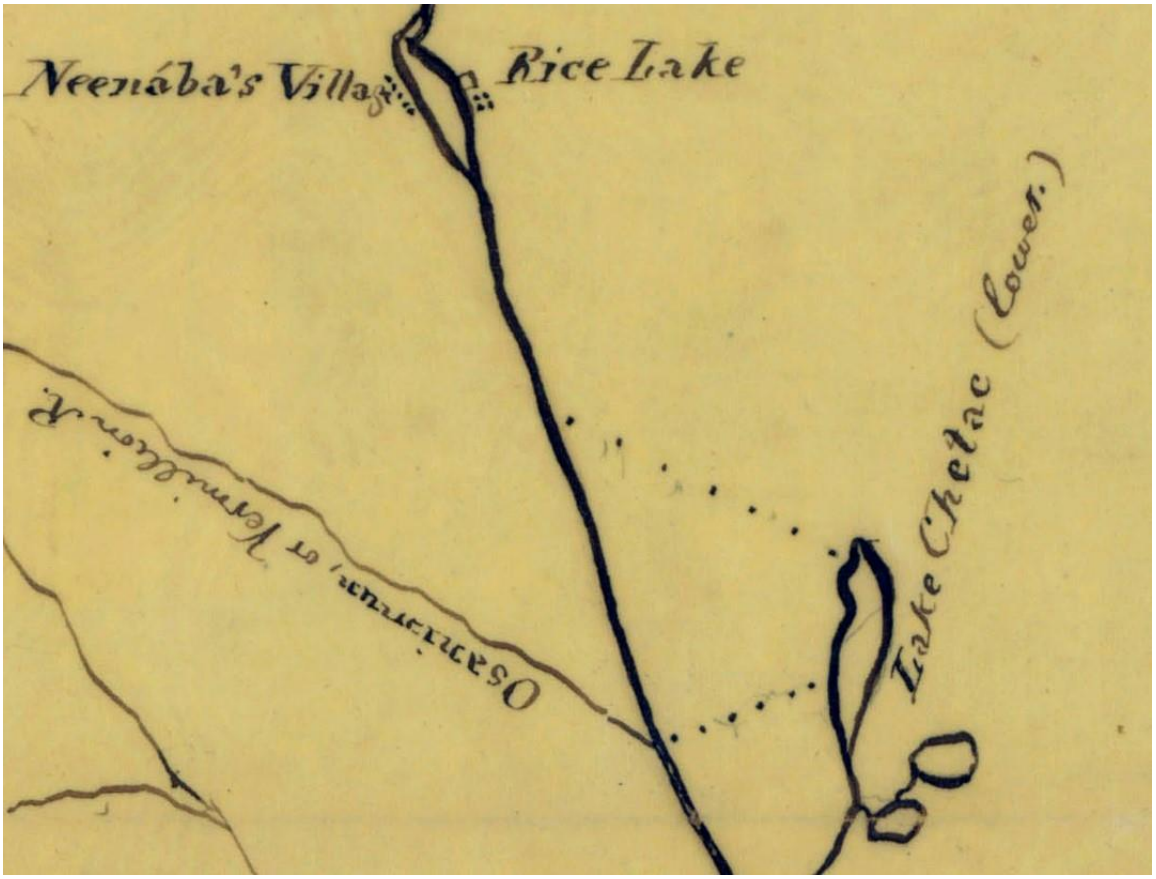

Figure 9: Detail of Neenaba's Map. Dot symbols representing the village and trails to and from lake Chetac

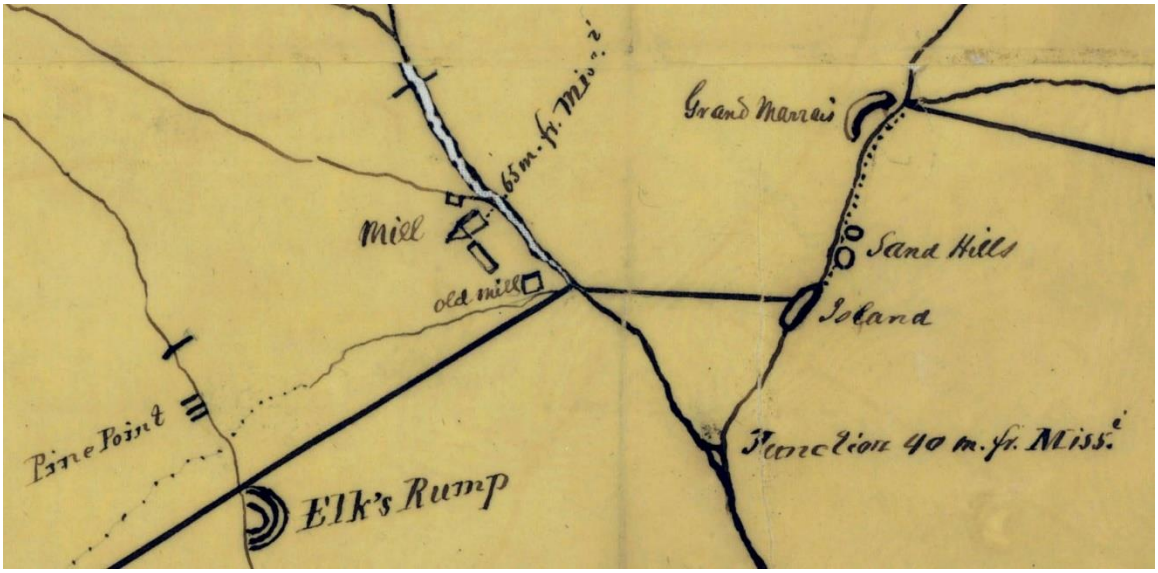

Figure 10: Detail of Neenaba's Map. Showing symbols representing landmarks, mills, and trails. The rapids of the Red Cedar marked in white

Neenaba's map contains slightly different symbology than the Wahpekute Map. He used dotted lines to represent trails, and dots to represent his village (Figure 9). He also used small rectangles to represent the mills (Figure 10). It is also interesting to note the differences in river symbology. Whereas the Wahpekute map uses river outlines with meanders, Neenaba used single lines and weights, mostly running relatively straight, similar to the 1837 Ioway map (Whelan 2003). This exemplifies how Indigenous maps were graphical representations of mental maps, which tend to simplify features for the sake of navigation and representing the network more accurately than each individual meander (Mitchell 2014). One explanation for the differences could be that Major Taliaferro took a bit of artistic liberty when copying the map to paper, but there is no way to know for sure.

When looking at the annotations, we know that a "Mr. Johnson" translated the labels on Neenaba's map. On the Wahpekute map it is unclear how much was added by Taliaferro in terms of labels, but the title of the map and suggestion of the necessity of a fort are clearly his. When William Clark forwarded the map to Commissioner Herring, he also commented on the map's accuracy, and added some of his own annotations, shown on figure 11:

> Major Taliaferro has also enclosed a sketch of the Indian Country to which he refers, which is in my opinion very inaccurate; his impressions as derived from the Indians, in relation to the direction of the line established and the country ceded by them, are also in my opinion incorrect. Those matters were fully discussed and were well understood at two treaties (1825 & 1830), and I am of opinion that the Sioux will be perfect fully satisfied with the lines, so soon as the surveys will be completed.

> I have sketched on major Taliaferro's map in red ink the true point of departure of the line between the Sacs and Foxes and the Sioux as so-established between those tribes at the Treaty of Prairie du Chien of 1825—and the cessions made by them respectfully, to the U States, on the North and South of said line, in 1830, from which it will be seen that the portion ceded by the Sioux bears but a small proportion to the country which they claim.
>
> I herewith also enclose a duplicate of the plat of major Boone's survey of the country in question so far as the work has been recorded(?) (Clark 1833).

It is interesting to note how vehemently he deplores the map's inaccuracy, especially considering his own unique familiarity with Indigenous maps during his expedition to the Pacific.

Figure 11: Detail from Wahpekute Map: William Clark's annotation can be seen across the center of the map highlighted in red. The Wahpekute-drawn line in blue (highlighting by me)

The features on each map were likely included by the Wahpekute and Neenaba for significant reasons. Obviously, certain features are required to draw the treaty lines because they are referred to in the treaties, but other features are not so clearly needed. Neenaba's map includes little more than what is defined by the treaty article, but the

Wahpekute map includes much more over a much larger area (Figure 12). The boundary between the Ojibwe and Sioux is 299 miles and the boundary between the Sac and Fox and Sioux is only 223 miles long. In addition, the Wahpekute map stretches all the way from the confluence of the Des Moines and Mississippi to Fort Snelling, and across to the headwaters of the Des Moines, an area of over 60,000 square miles, whereas Neenaba's map details only about 6000 square miles, from the confluence of the Chippewa and Clearwater rivers to the Mississippi River, to lake Saint Croix and then to Rice Lake.

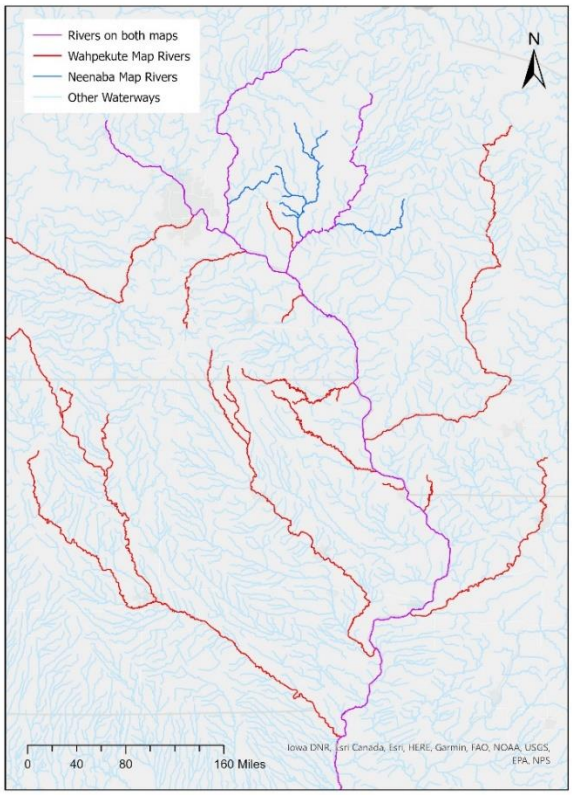

Figure 12: Map of rivers included on the two maps: red features are on the Wahpekute map, dark blue rivers are on Neenaba's Map, purple rivers are on both maps, light blue rivers are on neither map

Map Accuracy and Georeferencing Results

So how accurate is each map, what was their impact, and how does GIS help to uncover the information in each? Although I will compare different georeferencing methods, it will be mostly in the context of the treaty boundaries drawn by Neenaba and the Wahpekute. I have two maps (one for each Indigenous map) which compare the surveyed treaty lines, my interpretation of the Indigenous-drawn lines, and the Indigenous-drawn lines in each of the georeferencing methods. This comparison is for the purpose of determining the Indigenous vs. surveyed interpretations of the treaty wording, and the spatial arguments inherent in the maps themselves.

Using georeferencing tools in ArcGIS Pro allow these more methods of interpretation for these historic maps by registering them on the earth's surface. The features on the map can then be visualized compared to real-world physical and political features. ArcGIS Pro offers several options for georeferencing transformations and rubbersheeting methods. These include Similarity Polynomial, 1st Order Polynomial, 2nd Order Polynomial, 3rd Order Polynomial, Adjust Transformation, Projective Transformation, and Spline rubbersheeting (See Appendix C for a description of each transformation method). The accuracy of each method is recorded in tables 1 and 2. Forward residual is the error in the units of the spatial reference (in this case, meter), and inverse residual is the error measured in pixels, and the forward-inverse is a pixel measure of the closeness of the method's accuracy. However, accuracy and usefulness do

not always go hand in hand, and especially for maps drawn from memory, it is often more useful to preserve legibility at the expense of higher error.

For 3rd order and spline transformations the forward and inverse residuals are zero. This is because for each of these transformation methods the source control points are fixed exactly to target control points, warping the raster to their location. Typically, these methods are better at smaller scales. A typical rule of thumb for polynomial transformations is that the rougher the terrain, the higher the order. This means that 1st order transformations are typically suited for flat terrain like the Upper Mississippi Valley, while 3rd order is typically used for mountainous regions. For the adjust transformation the forward residual is high (though not as high as the other transformations), while the inverse is relatively low. This is because the adjust transformation uses both a polynomial transformation along with triangulated irregular network (TIN) interpolation. Although the target and source control points are not matched exactly, they are adjusted using interpolation to be a better match than 1st order or 2nd order polynomial transformations.

Table 1: Wahpekute Georeferencing Error Total

	Similarity	1st Order	2nd Order	3rd Order	Adjust	Projective	Spline
Forward Residual	62,739.4	44,055.8	30,455.3	0	11,549,454.2	41,648.7	0
Inverse Residual	471.9	313.7	203.4	0	63.2	291.8	0
Forward-Inverse	0	0	116.8	0	106.7	0	0

Table 2: Neenaba Georeferencing Error Total

	Similarity	1st Order	2nd Order	3rd Order	Adjust	Projective	Spline
Forward	22,622.8	15,151.9	8,199.6	0	11,684,045.9	9,611.3	0
Inverse	480	226.3	134.2	0	76.7	441.9	0
Forward -Inverse	0	0	55.4	0	67.3	0	0

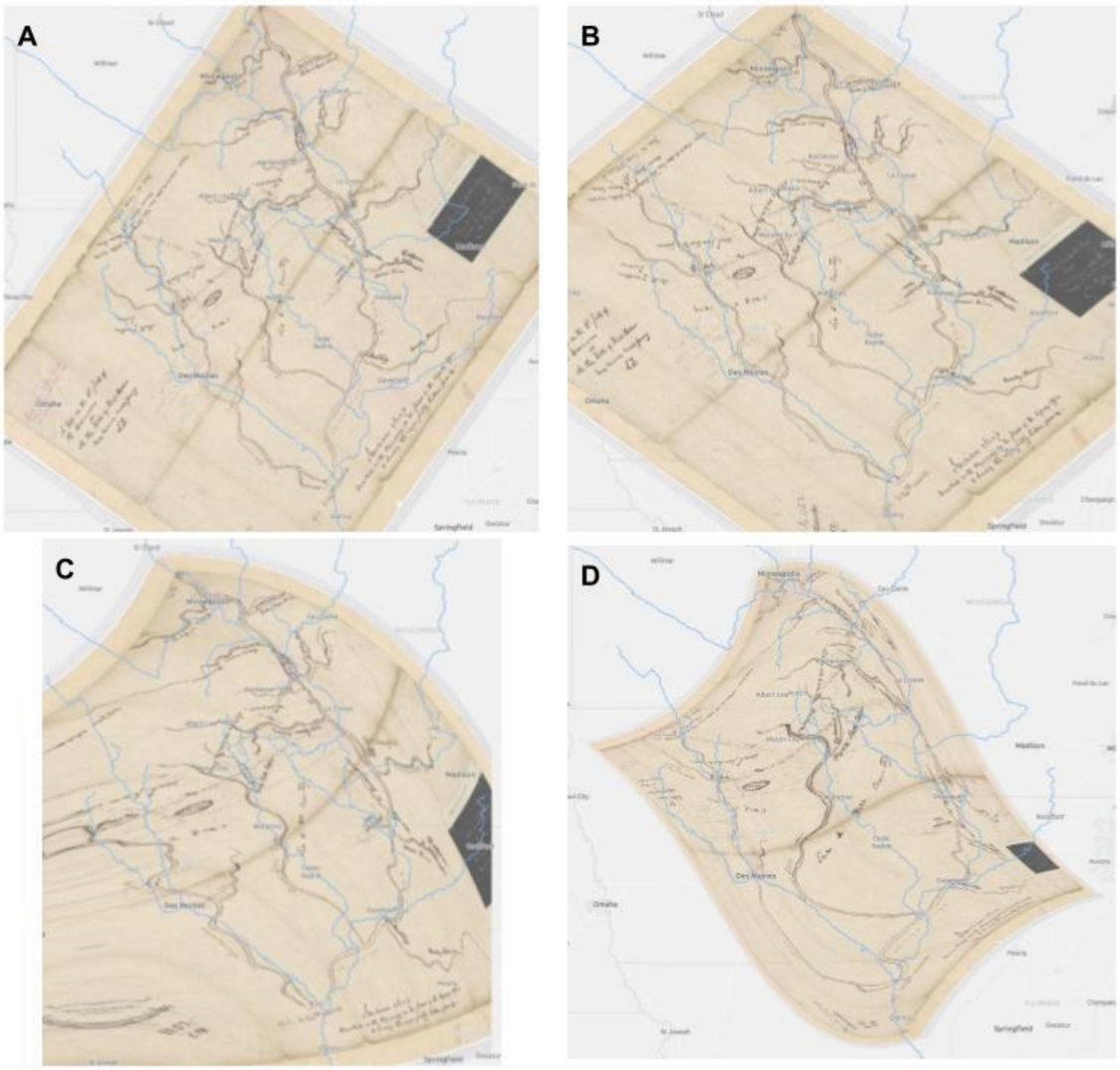

Figure 13: Wahpekute Map georeferenced using the similarity polynomial (A), 1st order polynomial (B), 2nd order polynomial (C), and 3rd order polynomial (D)

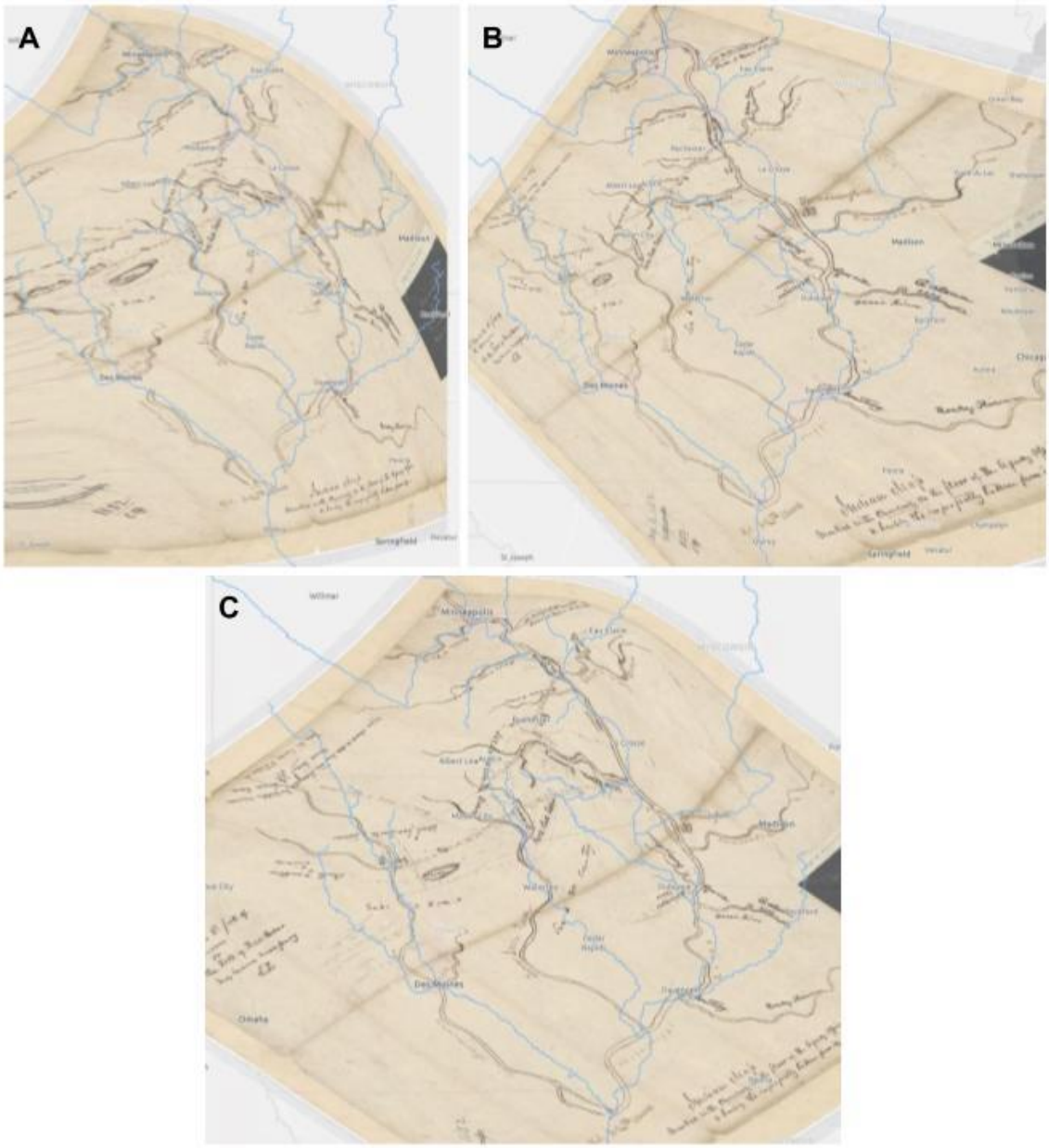

Figure 14: Wahpekute Map georeferenced using the adjust (A), projective (B), and spline (C) methods

Figures 13 and 14 illustrate the effect of the different transformations on the Wahpekute map. I adjusted the Wahpekute Map to have a transparency of 40% and included the real

locations of the labelled rivers for purposes of comparison. Each of the georeferenced versions of the map along with all of those of Neenaba's map will be available with the rest of the data. When examining these maps, it becomes clearer why William Clark called them "inaccurate." For example, the Raccoon Fork of the Des Moines River is shown flowing in from the East, where in reality, it flows in from the West side of the Des Moines. Additionally, the map references and third fork of the Des Moines, but there are only two major forks on that river.

Overall, none of the georeferencing transformations was above the rest, however I found that a combination of the similarity, 1st order, and spline methods was most useful for identifying the probable locations of unlabeled streams on both the Wahpekute and Neenaba maps. Most methods heavily distorted the maps, especially the 2nd order, 3rd order, and adjust methods. This might have been reduced had I chosen substantially more control points than 10, which is the absolute minimum for the 3rd order and spline transformations. However, the lack of substantial detail on each map reduced my ability to evenly space a large number of points over the map area. In addition, the river channels could have changed significantly from the 1830s to the present day. The first order transformation made sense given the flat study area, and it (along with the similarity transformation) was most useful for striking a balance between legibility and accuracy. Overall, the spline method led to the closest fit for the features on both maps. Georeferencing was a useful tool with which to examine these maps and the visualizations enabled a greater understanding of each map's contents.

Figures 15 and 16 Depict the treaty lines drawn by Neenaba and the Wahpekute with each georeferencing method applied, with one exception. The line generated by the projective method on Neenaba's Map was so warped that it was not worth including. These maps provide a clear comparison of the distortion created by each transformation method. Looking at these maps allows us to further visualize Neenaba and the Wahpekute's claims over the treaty lines.

The inset on Figure 15 shows that each of the georeferencing methods (along with my idea of Neenaba's line) produced a result where the actual treaty line was much further than the surveyed line. Looking at the treaty article's text explains why:

> It is agreed between the Sioux and the Chippewas, that the line dividing their respective Countries shall commence at the Chippewa River, half a days march below the falls; and from thence it shall run to Red Cedar River immediately below the Falls; from thence to the St Croix River, which it strikes at a place called the Standing Cedar, about a days paddle in a Canoe, above the Lake at the mouth of that River… (Ratified Treaty No. 139)

The difficulty of this situation is that given the fact that the rapids of the Red Cedar there are multiple falls on each river, which may or may not have been used by millers, and the subjectivity of a day's paddle or march. Henry Rowe Schoolcraft put it best in his report from his visit to Neenaba:

> "The rapids of the Red Cedar River extend (according to the estimates contained in my notes) about twenty-four miles. They commence a few miles below the junction of Meadow River, and terminate about two miles below the mills. This extension of falling water, referred to in the treaty as a fixed point, has led to the existing uncertainty. The country itself is of a highly valuable character for its soil, its game, its wild rice, and its wood. We found the butternut among those

> species which are locally included under the name of Bois franc, by the traders. The land can, hereafter, be easily brought into cultivation, as it is interspersed with prairie; and its fine mill privileges will add to its value. Indeed, one mile square is intrinsically worth one hundred miles square of Chippewa country, in some other places."

It is no wonder, then that Neenaba, along with many of the other Ojibwe in the area, considered this point particularly important to decide. Unfortunately, Schoolcraft's suggestion of another meeting between all parties to resolve the issue or even a fort at the Red Cedar never came to fruition. Schoolcraft also stated in his report that "wherever that line may be determined, in a reasonable probability, to fall, the mill itself cannot be supplied with logs for any length of time, if it is now so supplied, without cutting them on Chippewa lands, and rafting them down the Red Cedar. Many of the logs heretofore sawed at this mill, have been rafted up stream, to the mill. And I understood from the person in charge of it, that he was now anxious to ascertain new sites for chopping" (Schoolcraft 1855).

Clearly the business of logging was highly profitable, and in fact, it was only a few years later in 1837 that the Ojibwe ceded this territory to the United States in the Treaty of St. Peter's, primarily to guarantee access to these lands for exploitation by loggers. The Ojibwe did, however, retain usufructuary rights to hunting, fishing, and gathering in this territory, rights which were upheld in the supreme court decision *Minnesota v. Mille Lacs Band of Chippewa Indians* (526 U.S. 172 1999). In the end, Neenaba had a great understanding of the treaty and the economic and cultural value land he lived on. He used this map to provide proof of his knowledge and his peoples' use of

the land, which had profound effect on Schoolcraft as a government official. The use of GIS to analyze his map allows us to read the map more deeply in its textual and in a historical context.

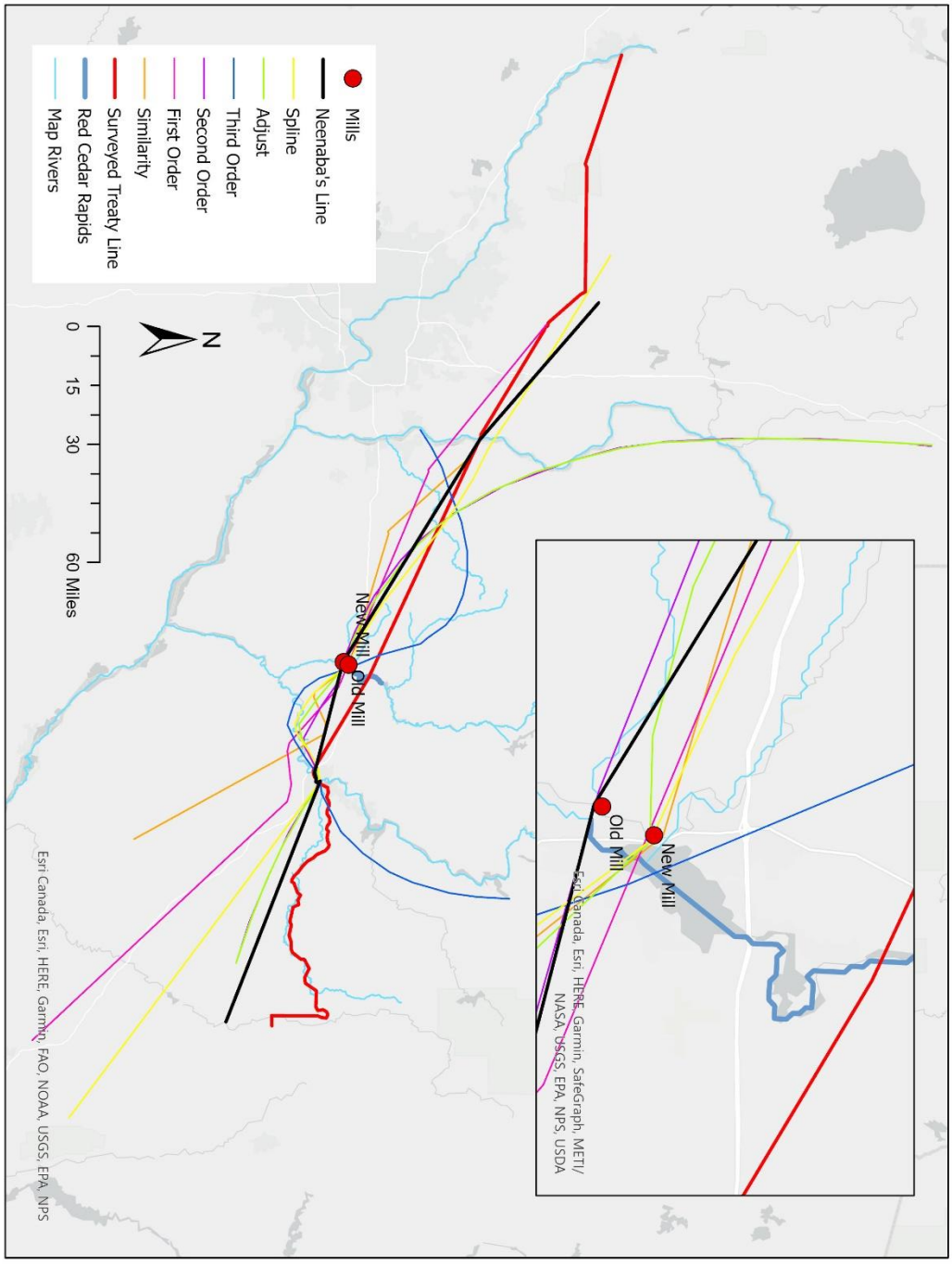

Figure 15: Neenaba's Map Treaty Line Georeferencing Comparison

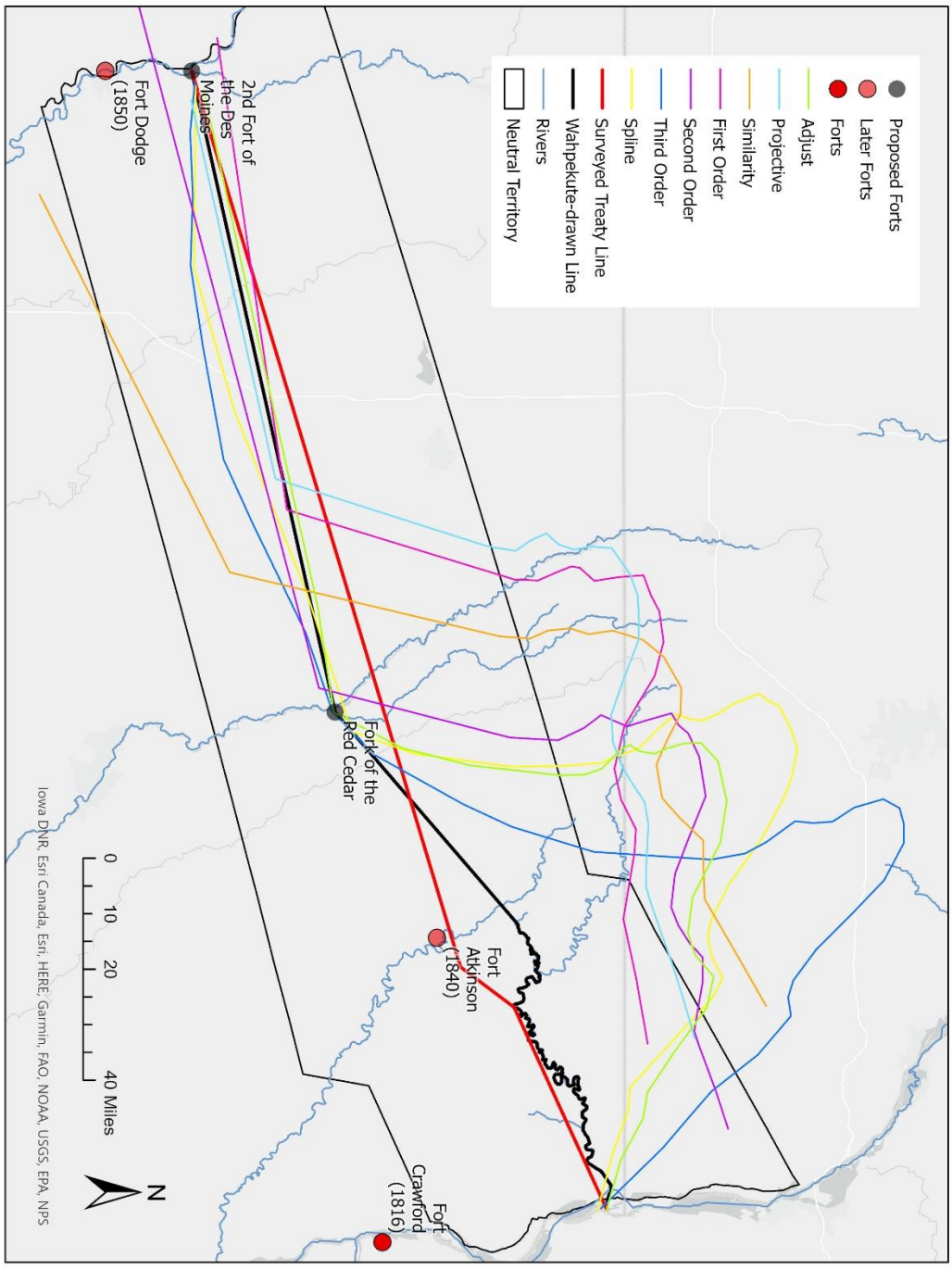

Figure 16: Wahpekute Map Treaty Line Georeferencing Comparison

The Wahpekute map has a similar yet slightly different context. Let us first consider the article from the 1825 Prairie du Chien treaty defining the border between the Sac & Fox and the Sioux:

> It is agreed between the confederated tribes of the Sacs and Foxes and the Sioux that the line between their respective Countries shall be as follows, Commencing at the mouth of the upper Ioway river, to the west bank of the Mississippi, and ascending the said Ioway river to its left fork; thence up that fork to its source; thence crossing the fork of Red Cedar River, in a direct line, to the second or upper fork of the Des Moines River; and therein a direct line to the lower fork of the Calumet River and down that River to its juncture with the Missouri River… (Ratified Treaty No. 139)

This treaty article contains the same lack of concrete wording as the article drawing the boundary between the Sioux and Chippewa. As can be seen on Figure 16, the Wahpekute and surveyor interpreted the starting point as the same, but the Wahpekute were under the impression that the line followed the Upper Iowa river rather than running in a straight line to its fork. Also, the "left fork" referred to could be any number of creeks and streams including Silver Creek, Ten Mile Creek, and Trout Creek, in the vicinity of modern-day Decorah, IA. I assumed for the purpose of drawing the Wahpekute line that they were thinking of Ten Mile Creek, which is the largest tributary on the left side of the river. It is also confusing that the treaty says "crossing the fork of Red Cedar River" which could be interpreted as crossing at the fork or just straight across the fork. In this case, I think both the Wahpekute and the officially surveyed line could be considered valid. In either case, two additional treaties had already been signed using that line by the time Taliaferro was petitioned by the Wahpekute. The 1830 treaty of Prairie du Chien

ceded twenty miles on either side of the line as “neutral territory” between the Sioux and Sacs & Foxes, presumably to reduce hostilities. In addition, an 1832 treaty signed at Fort Armstrong set aside the neutral territory to the east of the Red Cedar River as Winnebago land, after their removal to the west of the Mississippi River (Ratified Treaty No. 169).

Overall, the Wahpekute line was not that different from the surveyed line (figure 17), but because of the distortion on the hand-drawn map, the georeferenced boundaries show how much the claim would have actually changed. Interestingly, if the line were to be changed at all, it would likely have reduced the amount of territory set aside for the Sioux. In this light, the map can be seen as less of a land claim and more of a diplomatic expression of power. The fact that the Wahpekute men sought to dispute the line suggests that the territory was well-known to them, and that they still held geopolitical power in the region, even though the land had already been legally ceded. It is likely that William Clark was so quick to dismiss this map not only because of some inaccuracies, but also because these lines had already been surveyed and reinforced in multiple treaties. Unfortunately, the response of Commissioner Herring to Major Taliaferro has never been found, so there is no way of knowing for certain his response.

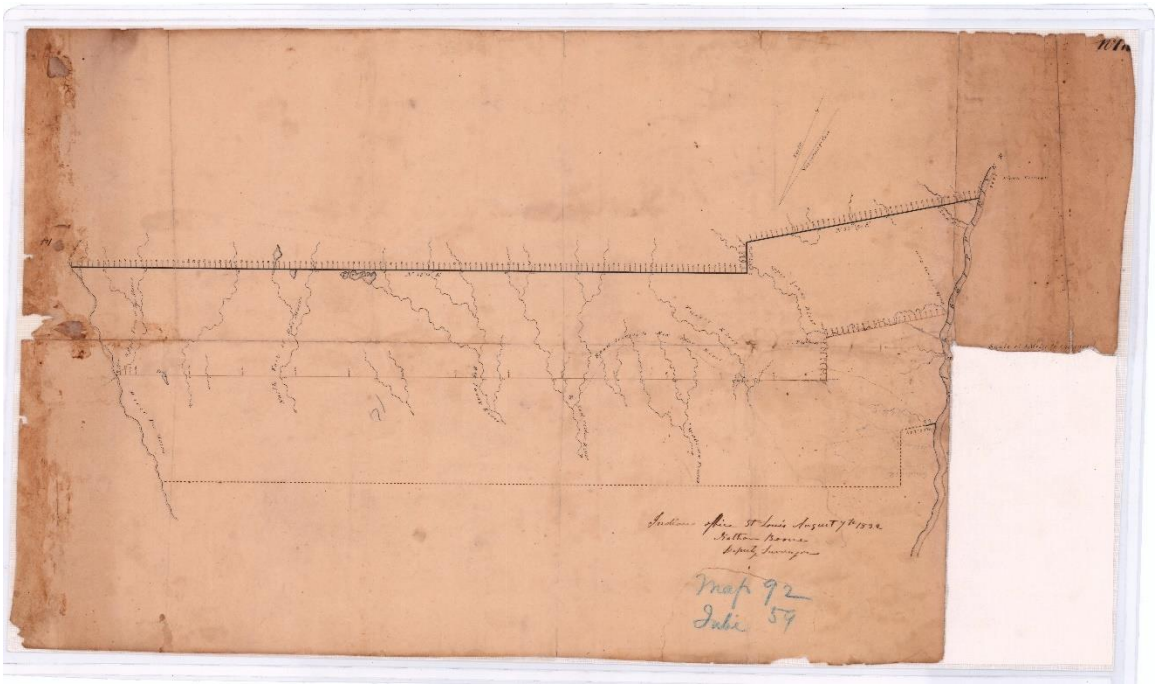

Figure 17: Major Nathan Boone's 1832 survey of the "neutral territory" between the Sac & Fox and Sioux (Map of Iowa)

On Taliaferro's copy of the Wahpekute map, he also suggests forts be built at either the 2nd fork of the Des Moines, or on the Fork of the Red Cedar. At the time, the closest American military presence was at Fort Crawford, Fort Snelling, and Fort Armstrong. Eventually forts were built near each of those locations: Fort Atkinson in 1840 and Fort Dodge in 1850. Neither fort lasted more than a decade and were rendered obsolete after the Winnebago were removed to Minnesota in 1848 and after the Sioux were forcibly relocated to reservations along the Minnesota River in 1851.

Within the two decades between 1830 and 1850 the stance towards American Indians in the Upper Mississippi Valley went from keeping the peace between groups and

preventing encroaching Euro-American settlements, to removing Tribes further and further west while diminishing their lands due to the "overwhelming tide of migration...increasing and irresistible in its westward progress" (Ratified Indian Treaty 258). Although these maps show the will of tribal groups to engage the US Government in good-will and on their own terms, ultimately their petitions led to little change in policy. These maps also show the complex relationship between Tribal groups, Indian agents, and the US government, and that people like the Wahpekute group who visited Taliaferro and Neenaba viewed themselves as on the same level as the government, with treaties being an agreement between equals, and settled with equal say by all parties. The Wahpekute and Neenaba maps are a testament to the importance of geographic visualization on US-Indian relations and on treaty lands. Using GIS along with accompanying primary sources allows these maps to tell a much deeper story about US-Indian diplomacy and Indigenous sovereignty.

Story Mapping Results

As part of my methodology, I presented the analysis of these two Indigenous maps as an ArcGIS StoryMap. Story maps, despite their name, are much more like blogs than maps. They are web applications which are text-based but have the ability to include all kinds of media. Their advantage lies in their ability to guide the user through a story using media, and to contextualize places with the inclusion of those additional media.

Story maps have a low barrier of entry, and the interface is much more user-friendly than ArcGIS Pro or even Microsoft Word and Power Point. Although one can make a story map in ArcGIS Online, they do benefit from having additional resources such as ArcGIS Pro. I did all of my GIS analysis in ArcGIS Pro, and I know that if I had to do it in the less-powerful ArcGIS Online it would have been much more difficult. ESRI includes many built-in visualizations as well as their living atlas of geographic data, and the ability to make express maps, which is a straightforward way to make simple maps using points, lines, and polygons. Another advantage of story maps is that they are easy to make public and to share, enabling ease of use not only for the creators, but also for readers of Internet communities. Story maps' greatest strength is their effectiveness in making subject matter interesting, engaging, and understandable, and using creativity and design to successfully communicate.

To conclude, using GIS to analyze Indigenous maps is an effective tool, but only through contextualization using related primary sources and historical context. A more structured story of these letters and treaties along with large-scale imagery and interactive map layers in the form of a story map allows readers to appreciate these results even more. In this light, the use of a story map for presenting Indigenous mapping in general would make sense for future projects of a similar historical-critical method.

DISCUSSION

The georeferencing of these two maps to determine treaty lines is only one of many practical routes for which Indigenous maps and GIS intersect. Similar techniques have been used to aid in identifying archaeological and cultural sites (Whelan 2003), as a pedagogical tool (Palmer et al. 2021), understanding land tenure and toponymy (Cole & Hart 2021), and reviving and preserving Indigenous ontology (Griebel & Keith 2021). To add to this list, I would also suggest that story mapping, a relatively recent practice, has much in common with Indigenous mapping, and story maps can serve as a powerful tool for presenting Indigenous geographic knowledge and research.

Indigenous maps have unique and significant conventions which differ from Western map symbology and iconography. Historically, Indigenous maps tend to have a lot in common with mental maps, such as emphasizing the familiar and deemphasizing the unfamiliar, oversimplifying for ease of memory, scaling to travel time rather than measured distance, and sizing symbols based on cultural importance (Mitchell 2014). In addition, Indigenous maps are often performative documents: they record important biographical details, cosmological events, and migration patterns. In Indigenous Mexico it was common to paint footprints on the map, physically animating the image by showing how the artist moved through space (Figure 18).

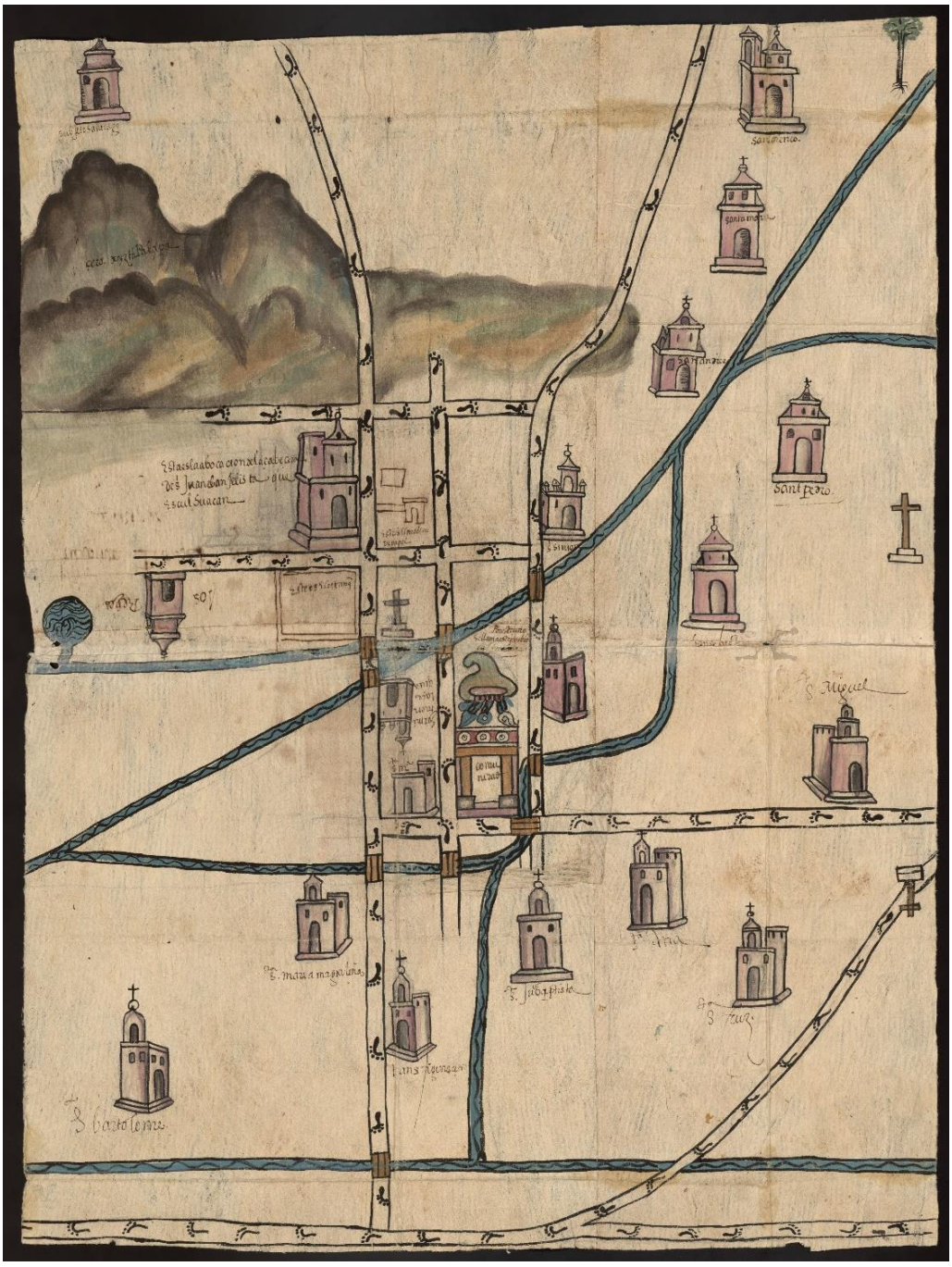

Figure 18: Culhuacán, Mexico (Culhuacán, Mexico)

These unique qualities that define Indigenous geographies require a unique platform of spatial representation. And story maps seem like a promising route for Indigenous mapping. Story mapping is a process which "enables communities to incorporate their own voices, languages, names, and stories into maps" (Palmer & Korson 2020). Story maps allow communities to integrate their own voices, toponyms, and stories into maps through the use of multiple forms of media. The most widely known story mapping platform is ArcGIS Online story maps, a free online tool from ESRI. This tool allows you to "create inspiring, immersive stories by combining text, interactive maps, and other multimedia content" (ArcGIS StoryMaps).

Many tribes have already used story maps as educational resources for both tribal members and the general public. One example is *Indian Land Cessions in Minnesota*, created by the Red Lake Tribal Historic Preservation Office. It tells the story of each treaty and displays territory and historic villages. The map also won ESRI's 2019 Tribal Story Map Challenge (ESRI Tribal Story Map Challenge). Indigenous story maps can be a beneficial tool for Indigenous conservationists, resource managers, teachers, and the general public (Palmer & Korson 2020).

Story mapping enables the seamless integration of text, imagery, audio, video, and maps, in a way not dissimilar from how Indigenous maps have been historically used to record stories, events, journeys, toponymies, and cultural sites. Story maps give more creative liberty to mapping, and Indigenous maps themselves often toe the line between objective accuracy and art. Amos Bad Heart Bull's role as official tribal historian of the

Oglala Lakota in the late 19th and early 20th centuries required him to try to record events as objectively as possible, but in his strict devotion to detail his ledger art became art as much as record (Bad Heart Bull & Blish 2017). Some Indigenous peoples still practice traditional mapping and art techniques in the modern day. Marlena Myles is a contemporary Dakota artist whose work often takes influence from Indigenous art. Her stylized map of the Twin Cities (Figure 19) uses pictographs, emphasizes the familiar and topology over Euclidean space, and includes Dakota toponymy and stories, all practices common to Indigenous maps such as Amos Bad Heart Bull's map of the Black Hills (Figure 20). Story maps have the potential to enable many of the same techniques, although in a more structured way with a lower barrier to entry. Making a story map takes less time than a standalone map by using templates, and the tool is free and easy to learn. In addition, there are other less-structured story mapping tools available like Nunaliit, a web mapping framework expressly developed for use in preserving Indigenous knowledge using maps (Nunaliit by GCRC).

GIS alone is limited in its application to present Indigenous knowledge, but digitization is greatly enhanced by story mapping. Indeed, story maps often reflect principles of indigenous geography and mapping as shown by the above examples. GIS and story mapping are a promising tool for incorporating Indigenous mapping practices into geographic research, whether it be a historical map analysis or a collaboration with a contemporary Tribal group.

Figure 19: An artistic rendering of the Twin Cities in the Dakota Language, an example of decolonial Indigenous mapping (Myles)

Figure 20: Detail of Amos Bad Heart Bull's Map of the Black Hills showing toponymy and pictography

CONCLUSION

> Although decolonizing and Indigenizing the *content* of maps is an important aspect of decolonial mapping, the *protocols* that inform the mapping process are just as significant, if not more so. (Rose-Redwood et al. 2020)

Given that Indigenous mapping can both show the world in a new way as well as challenge the settler-colonial spatial hegemony, what are the best ways to integrate it into our research practices? It is not as simple as teaching GIS in every Indigenous community or engaging in participatory mapping projects but may include aspects of each. As shown above, using GIS and Story Maps to engage with Indigenous mapping offers a promising direction. What is certain is that we must rethink the world from the perspective of Indigenous knowledge. What is also certain is that Indigenous sovereignty must be respected. Indigenous communities must lead collaborative mapping processes if they are to be in their best interests, but it could also provide a more subjective view, like a map of emotions or stories.

As long as geographic researchers are open to Indigenous ideas about what is considered valid research and knowledge, and open to adopting those ideas, we are making progress towards incorporating Indigenous perspectives into an increasingly diverse body of knowledge. Research done in collaboration between geographers and Indigenous peoples where they are treated as equals, take a role in designing the research goals, and their own protocols are respected, is decolonial work (Hayward et al. 2021). De-colonialism is not an end goal, but a continuous process of re-discovery and affirmation of Indigenous ways of living. This affirmation has many avenues within

geographic research such as this project, as well as work that can be done collaboratively between academic geographers and Indigenous communities, including non-peer reviewed publications, helping to author community grant applications, supporting legal work, creating educational web resources, writing educational curricula and toolkits (see, for example, Tobias 2000 and Earth Defenders Toolkit), or simply volunteering your skills for whatever projects the communities are currently working towards (De Leeuw & Hunt 2018).

As a way for interpreting the landscape and communicating information, maps are an important educational tool. They help to contextualize and draw relationships as standalone objects, and with other forms of media can compound levels of detail. The usage of Indigenous maps and associated stories can play a particularly vital role in the interpretation of landscapes. For example, toponyms are an especially effective way to build stories into maps. While toponyms often act as labels that provide some sort of practical data (addresses, municipalities, states, etc.), in Indigenous culture they also provide a necessary human dimension on maps. When Indigenous people speak these names, they are not just speaking a name that someone long ago decided to call a place, they are literally repeating the words their ancestors spoke when establishing their original relationship to that place. Toponymic restoration is therefore a primary goal for decolonizing the map and maintaining linguistic integrity in cultures that were once exclusively oral based.

As noted, decolonizing the map is not an end state, it is a continuous process. While anti-colonial mapping is an affirmative step in decolonizing geography, such as analyzing Indigenous maps using GIS, the ultimate outcome of decolonial mapping recenters Indigenous voices and epistemologies. Many Indigenous intellectuals and cartographers are already setting the paradigm for this important work and will continue to do so whether such ideas gain more traction in the academy or not. At the same time, most of the teaching and research continues in a Western view of the world. Despite this, the inclusion of Indigenous geographies is an important part of moving beyond the colonial frame of current 'geographic tradition' (Rose-Redwood et al. 2020).

> It's all about relationships. As researchers, we have a responsibility to build relationships with the communities in which we work, defined by deep respect, humility, and generosity. The research will be better for it, as will our communities. No matter what culture, community, institution, or discipline we come from, we are each diplomats representing something bigger than ourselves; it is on us to represent those things in a good way, and to work with Indigenous communities and sovereign nations with the respect they command and the inherent self-determination they carry. (Lucchesi 2020)

My aim in this paper was to critically examine issues related to geographic research, and how Indigenous knowledge and mapping can be a way to both decolonize research as well as contribute to the goals of Indigenous communities. This research is conducted through an extensive literature review and examination of Indigenous maps using GIS and a Story Map. Based on the evidence laid out, I suggest several practices related to decolonizing the map: (1) as geographic researchers living and working in a settler-colonial state, we have the knowledge, skills, and responsibility to uplift Indigenous

communities where we live; (2) the best way to do this work is to learn from Indigenous knowledge, respect Indigenous research protocols, develop projects which have the foremost goal of creating lasting positive change in that Indigenous community, and build intellectual and communal relationships with that specific community. Prime examples of this type of research include Meisel et al. (2021), Country et al. (2016), and Palmer & Korson (2020). Lasting, real-world change is the best practice to decolonize our research practices. Specifically, I see GIS and Story Maps as powerful tools, both for practical use as well as a way to educationally engage Indigenous youth and the wider public with Indigenous maps.

Maps (especially recent developments in mapping like ArcGIS Story Maps) can be a way to reclaim cultural resources for Indigenous groups. Maps made by Euro-American settlers have erased much of the native presence from North America, but maps can also be a way to decolonize the landscape. The evidence above suggests that Indigenous geographic knowledge and modern mapping techniques can be synthesized in anticolonial and decolonial work using GIS and story maps. Expanded mapping formats such as story maps and art which contextualize spatial information are doubly important for preserving tribal heritage, as data itself cannot describe the importance of the land as it is known in Indigenous traditions. This information is also relevant to non-Indigenous peoples in terms of research, historic interpretation, cultural education, etc.

Because maps have historically been used to shape Indigenous identity through drawing borders where there were none before, anti-colonial mapping done by

Indigenous peoples counters the colonial spatial hegemony (Eades 2015). The Wahpekute Map and Neenaba's Map are examples of this practice. What do we gain by including their voices in the larger history of our country? Indigenous peoples' lives, communities, languages, and cultures continue to be threatened by settler colonial institutions, and the work of decolonization has the power to address these real-world problems (De Leeuw & Hunt 2018). No matter where we are, it is important for us as geographers to recognize that "drawing on ancestral knowledge and mapping practices, and lifting up the stories and needs of modern tribal communities, centers Indigenous people" (Camhi et al. 2020), and that by engaging with Indigenous knowledge, we can tell stories about places in a more meaningful way.

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APPENDIX A – Description of Geospatial Data Files Used

An ArcGIS Project Package of my thesis project is available for the public, linked here:

https://arcg.is/1raLvj

My ArcGIS StoryMap is linked here:

https://arcg.is/19r54q0

1. Wahpaa.aprx – My ArcGIS Pro project file. This file contains three maps and two layouts and is how I worked with the data

Geoprocessing Files

1. Image_Mensuration – measurements taken to determine river distances, and the rough area of each map

2. NeenabaRivers.shp – selection of rivers included on the Neenaba Map

3. NeutralTerritory_Dissolve.shp – neutral territory polygon between the Sioux and Sac & Fox

4. RedCedarRapids.shp – selected location from NeenabaRivers.shp of the rapids on the Red Cedar River

5. WahpaRivers.shp – Rivers included on the Wahpekute Map

6. WahpaRivers_Intersect – Rivers included on both the Wahpekute and Neenaba Maps

7. S_USA.TRIBALCEDEDLANDS.shp – Shapefile compiling all of Royce's land cession maps. Downloaded from the USDA website and used to extract the surveyed treaty boundaries (https://data.fs.usda.gov/geodata/edw/edw_resources/meta/S_USA.TRIBALCEDEDLANDS.xml)

8. rv16my07.shp – Shapefile of US river, downloaded from the National Weather Service, and used to identify the rivers on each of the two maps (https://www.weather.gov/gis/Rivers)

Basemap Files

1. AdjustedTreatyLine.shp – Surveyed treaty line on the Wahpekute Map

2. Forts.shp – Existing forts in the Upper Mississippi Valley on July 5th, 1833

3. Later_Forts.shp – Forts built in Iowa after 1833

4. Mills.shp – Locations of the two mills shown on Neenaba's map

6. ProposedForts.shp – The two fort locations proposed by Taliaferro

7. SiouxDrawnLine.shp – The Wahpekute interpretation of the treaty boundary as interpreted by me

8. SiouxOjibweLine.shp – The surveyed "Prairie du Chien line" between the Sioux and Chippewa

Georeferencing Files

1. NeenabaAdjust.shp – Neenaba's boundary line altered using the adjust transformation

2. NeenabaFirst.shp – Neenaba's boundary line altered using the 1st order polynomial transformation

3. NeenabaSecond.shp – Neenaba's boundary line altered using the 2nd order polynomial transformation

4. NeenabaThird.shp – Neenaba's boundary line altered using the 3rd order polynomial transformation

5. NeenabaSimilarity.shp – Neenaba's boundary line altered using the similarity transformation

6. NeenabaProjective.shp – Neenaba's boundary line altered using the projective transformation

7. NeenabaSpline.shp – Neenaba's boundary line altered using the spline transformation

8. NeenabaLine.shp – Neenaba's boundary line

9. WahpekuteAdjust.shp – The Wahpekute boundary line altered using the adjust transformation

10. WahpekuteFirst.shp – The Wahpekute boundary line altered using the 1st order polynomial transformation

11. WahpekuteSecond.shp – The Wahpekute boundary line altered using the 2ndorder polynomial transformation

12. WahpekuteThird.shp – The Wahpekute boundary line altered using the 3rd order polynomial transformation

13. WahpekuteSimilarity.shp – The Wahpekute boundary line altered using the similarity transformation

14. WahpekuteProjective.shp – The Wahpekute boundary line altered using the projective transformation

15. WahpekuteSpline.shp – The Wahpekute boundary line altered using the spline transformation

16. WahpekuteLine.shp – The Wahpekute boundary line

17. wah_paa_koo_ta_Map.jpg – The unaltered JPG image of the Wahpekute Map. Downloaded from NARA at 7167 x 5795 pixels

18. Neenaba's_Map.jpg – The unaltered JPEG image of Neenaba's Map. Downloaded from NARA at 5288 x 5862 pixels

19. NeenabaGCP.txt – The coordinates of the 10 CGPs for Neenaba's Map

20. WahpekuteGCP.txt – The coordinates of the 10 GCPs for the Wahpekute Map

APPENDIX B – Letters and Treaties Referenced

Treaty of Prairie du Chien, 1825, Article 5:

"It is agreed between the Sioux and the Chippewas, that the line dividing their respective Countries shall commence at the Chippewa River, half a days march below the falls; and from thence it shall run to Red Cedar River immediately below the Falls; from thence to the St Croix River, which it strikes at a place called the Standing Cedar, about a days paddle in a Canoe, above the Lake at the mouth of that River…"

Treaty of Prairie du Chien, 1825, Article 2:

"It is agreed between the confederated tribes of the Sacs and Foxes and the Sioux that the line between their respective Countries shall be as follows, Commencing at the mouth of the upper Ioway river, to the west bank of the Mississippi, and ascending the said Ioway river to its left fork; thence up that fork to its source; thence crossing the fork of Red Cedar River, in a direct line, to the second or upper fork of the Des Moines River; and therein a direct line to the lower fork of the Calumet river and down that River to its juncture with the Missouri River…"

Treaty of Prairie du Chien, 1830, Article 2:

"The confederated Tribes of the Sacs and Foxes, cede and relinquish to the United States forever, a tract of Country twenty miles in width, from the Mississippi to the Demoine; situate south, and adjoining the line between the said confederated Tribes of Sacs and Foxes, and the Sioux; as established by the second article of the Treaty of Prairie du Chien of the nineteenth of August one thousand eight hundred and twenty-five."

Treaty of Prairie du Chien, 1830, Article 3:

"The Medawah-Kanton, Wah-pa-coota, Wahpeton and Sisseton Bands of the Sioux cede and relinquish to the United States forever, a Tract of Country twenty miles in width, from the Mississippi to the Demoine River, situate north, and adjoining the line mentioned in the preceding article."

Letter from Lawrence Taliaferro to Elbert Herring, July 5th, 1833:

"It becomes my duty to apprise you of the sentiments of the Wah paa Koo ta Sioux in reference(?) to the line which was commenced to be seen by our surveyors last spring – the chiefs, and head(?) men say- "They did not expect any advantage would be taken as to the wording of the treaty in calling for the line from the fork of Red Cedar River to the 2nd or upper fork of the river Desmoines in a Straight line".- They now ask through me as their advisor, and council at the Treaties of 1825, and 30 at Prairie du Chien, that the Central line as in 1825 pass(?) to the 2nd fork of the river Desmoines this being the first above the Racoon Fork on said stream – My reply is as follows. "As to your line from the fork of Red Cedar to the 2nd fork of the Desmoines – your Great Father will do you justice, and will permit no advantage to be taken of any oversight in your treaties with him – I will write immediately"—I am positive myself that the Indians are correct, but I have not, nor shall I, say a word- except to the government.- of my own corrections(?) after(?) the surveys. – I have the honour to be yr. mo aff serv

P.S. An Indian Map accompanies this Law Taliaferro

letter shewing their ideas of the line Indian Agent at St. Peters

as agreed upon in 1825 and 30—

"

Letter from Lawrence Taliaferro to William Clark, July 5th, 1833:

"General –

I have herewith enclosed to you a letter for the Commissioner of Indian Affairs of Washington.- The sentiments of the Indians who claim the Country from the fork of Red Cedar to the 2nd fork of the Desmoines are communicated(?) by myself in special council(?).- It is to be distinctly understood that the WahpaaKooTa are perfectly satisfied with the sale(?) of their portion of land to the United States- but are utterly averse to any constrictions(?) of the treaty of 1830 which takes(?) the line from the 2nd fork of the river Desmoines—I can assure you that if you take the line out of this course, and carry it to, or at a small(?) fork near the source of said river, and then take twenty miles width of this

point for the United States- you leave this people without support and so contrary to their ?? conception of the treaties of 1825 and 30 –

I have the honour to be yr. mo aff serv

Law Taliaferro

Indian Agent at St. Peters

”

Letter from William Clark to Elbert Herring, July 21st, 1833:

“Sir

Herewith I have the honor to transmit you a letter to your address, from Major Taliaferro, Indian Agent at St. Peter’s—also his general communications to me of the 4th and 5th inst.(?) on the subject of the visits of the Chippeways at his agency, and the Sioux boundary line—likewise his correspondence with Sub Agent Grooms in relation to the applications of the latter for leave of absence until next spring.

Major Taliaferro has also enclosed a sketch of the Indian Country to which he refers, which is in my opinion very inaccurate; his impressions as derived from the Indians, in relation to the direction of the line established and the country ceded by them, are also in my opinion incorrect. Those matters were fully discussed and were well understood at two treaties (1825 & 1830) and I am of opinion that the Sioux will be perfect fully satisfied with the lines, so soon as the surveys will be completed.

I have sketched on major Taliaferro’s map in red ink the true point of departure of the line between the Sacs and Foxes and the Sioux as so-established between those tribes at the Treaty of Prairie du Chien of 1825—and the cessions made by them respectfully, to the U States, on the North and South of said line, in 1830, from which it will be seen that the portion ceded by the Sioux bears but a ?? proportion to the country which they claim.

I herewith also enclose a duplicate of the plat of major Boone’s survey of the country in question so far as the work has been recorded(?).

With regard to the application of Mr. Grooms for leave of absence from his post, I can only state that the rule established by me does not admit of a longer period of absence

than two months—where an extension of the furlough is required beyond this point, it is referred to the department.

I have the honor to be with high respect yr. most ob. Serv.

Wm Clark

“

Excerpt from *Official Report of an Expedition through Upper Michigan and Northern Wisconsin in 1831*, Henry Rowe Schoolcraft, Sault Ste. Marie, Sept. 21, 1831

(Preceding this section Schoolcraft describes meetings with several Chippewa leaders as he descended from Lake Superior to the Chippewa River where they made known their qualms about the Sioux. Namely, that the Sioux continually cross the boundary line to commit murder against the Chippewa, and the Chippewa leaders just want peace with them)

“I found at Rice Lake a band of Chippewas, most of them young men, having a prompt an martial air, encamped in a very 'com pact form, and prepared at a moment's notice, for action. They saluted our advance with a smartness and precision of firing that would have done honor to drilled troops. Neenaba was absent on a hunting-party; but one of the elder men pointed out a suitable place for my encampment, as I intended here to put new bot toms to my bark canoes. He arrived in the evening, and visited my camp with forty-two men. This visit was one of ceremony merely; as it was late, I deferred anything further until the following day. I remained at this place part of the 7th, the 8th, and until 3 o'clock on the 9th of August. And the following facts present the result of several conferences with this distinguished young man, whose influence is entirely of his own creation, and whose endowments, personal and mental, had not been misrepresented by the Indians on my route, who uniformly spoke of him in favorable terms. He is located at the most advanced point towards the Sioux borders, and, although not in the line of ancient chiefs, upon him rests essentially the conduct of affairs in this quarter. I therefore deemed it important to acquire his confidence and secure his influence, and held frequent conversations with him. His manner was frank and bold, equally free from servility and repulsiveness. I drew his attention to several sub jects. I asked him whether the saw-mill on the lower part of the Red Cedar, was located on Chippewa lands? He said, Yes. Whether it was built with the consent of the Chippewas? He said, No; it had been built, as it were, by stealth. I asked him if anything had been subsequently given them in acknowledgment of their right to the soil? He said, No; that the only acknowledgment

was their getting tobacco to smoke when they visited the mill; that the Sioux claimed it to be on their side of the line, but the Chippewas contended that their line ran to a certain bluff and brook below the mill. I asked him to draw a map of the lower part of Chippewa River, with all its branches, showing the exact lines as fixed by the treaty at Prairie du Chien, and as understood by them. I requested him to state the facts respecting the murder of the Menomonie, and the causes that led to it; and whether he, or any of his band, received any message from the agent or commanding officer at Prairie du Chien, demanding the surrender of the murderer? To the latter inquiry he answered promptly, No. He gave in his actual population at 142; but it is evident that a very considerable additional population, particularly men, resort there for the purpose of hunting a part of the year.

The day after my arrival, I prepared for and summoned the Indians to a council, with the usual formalities. I opened it by announcing the objects of my visit. Neenaba and his followers listened to the terms of the message, the means I had adopted to enforce it, and, finally, to the request of co-operation on the part of himself and band, with strict attention. He confined his reply to an expression of thanks, allusions to the peculiarity of his situation on an exposed frontier, and general sentiments of friendship. He appeared to be mentally embarrassed by my request to drop the war-club, on the successful use of which he had relied for his popularity, and whatever of real power he possessed. He often referred to his young men, over whom he claimed no superiority, and who appeared to be ardently attached to him. I urged the principal topic upon his attention, presenting it in several lights. I finally conferred on him, personally, a medal and flag, and directed the presents intended for his band to be laid, in gross, before him.

After a pause, Neenaba got up, and spoke to the question, connecting it with obvious considerations, of which mutual rights, personal safety, and the obligation to protect the women and children, formed the basis. The latter duty was not a slight one. Last year, the Sioux had killed a chief on the opposite shore of the lake, and, at the same time, decoyed two children, who were in a canoe, among the rice, and killed and beheaded them. He said, in allusion to the medal and flag, that these marks of honor were not necessary to secure his attention to any requests made by the American government. And after resuming his seat. awhile (during which he overheard some remarks not pleasing to him, from an Indian on the opposite side of the ring), he finally got up and declined receiving them until they were eventually pressed upon him by the young warriors. Everything appeared to proceed with great harmony, and the presents were quickly distributed by one of his men. It was not, however, until the next day, when my canoes were already put in the water, that he came with his entire party, to make his final reply, and to present the

peace-pipe. He had thrown the flag over one arm, and held the war-club perpendicularly in the other hand. He said that, although he accepted the one, he did not drop the other; he held fast to both. When he looked at the one, he should revert to the counsels with which it had been given, and he should aim to act upon those counsels; but he also deemed it necessary to hold fast the war-club; it was, however, with a determination to use it in defence, and not in attack. He had reflected upon the advice sent to the Chippewas by the President, and particularly that part of it which counselled them to sit still upon their lands; but while they sat still, they also wished to be certain that their enemies would sit still. And the pipe he was now about to offer, he offered with a request that it might be sent to the President, asking him to use his power to prevent the Sioux from crossing the lines. The pipe was then lit, handed round, the ashes knocked out, and a formal presentation of it made. This ceremony being ended, I shook hands with them, and immediately embarked.

On the second day afterward, I reached the saw-mill, the subject of such frequent allusion, and landed there at 7 o'clock in the morning. I found a Mr. Wallace in charge, who was employed, with ten men, in building a new dam on a brook of the Red Cedar, the freshet of last spring having carried away the former one. I inquired of him where the line between the Sioux and Chippewas crossed. He replied that the line crossed above the mill, he did not precisely know the place; adding, however, in the course of conversation, that he believed the land in this vicinity originally belonged to the Chippewas. He said it was seven years since any Sioux had visited the mill; and that the latter was owned by persons at Prairie du Chien.

The rapids of the Red Cedar River extend (according to the estimates contained in my notes) about twenty-four miles. They commence a few miles below the junction of Meadow River, and terminate about two miles below the mills. This extension of falling water, referred to in the treaty as a fixed point, has led to the existing uncertainty. The country itself is of a highly valuable character for its soil, its game, its wild rice, and its wood. We found the butternut among those species which are locally included under the name of Bois franc, by the traders. The land can, hereafter, be easily brought into cultivation, as it is interspersed with prairie; and its fine mill privileges will add to its value. Indeed, one mile square is intrinsically worth one hundred miles square of Chippewa country, in some other places.

The present saw-mills (there are two), are situated 65 miles from the banks of the Mississippi. They are owned exclusively by private citizens, and employed for their sole benefit. The boards are formed into rafts; and these rafts are afterward attached together,

and floated down the Mississippi to St. Louis, where they command a good price. The business is understood to be a profitable one. For the privilege, no equivalent has been paid either to the Indians or to the United States. The first mill was built several years ago, and before the conclusion of the treaty of Prairie du Chien, fixing boundaries to the lands. A permit was given for building, either verbal or written, as I have been informed, by a former commanding officer at Prairie du Chien. I make these statements in reference to a letter I have received from the Department since my return, but which is dated June 27th, containing a complaint of one of the owners of the mill, that the Chippewas had threatened to burn it, and re questing me to take the necessary precautionary measures. I heard nothing of such a threat, but believe that the respect which the Chippewas have professed, through me, for the American government, and the influence of my visit among them, will prevent a resort to any measures of violence; and that they will wait the peaceable adjustment of the line on the rapids. I will add that, wherever that line may be determined, in a reasonable probability, to fall, the mill itself cannot be supplied with logs for any length of time, if it is now so supplied, without cutting them on Chippewa lands, and rafting them down the Red Cedar. Many of the logs heretofore sawed at this mill, have been rafted up stream, to the mill. And I understood from the person in charge of it, that he was now anxious to ascertain new sites for chopping; that his expectations were directed up the stream, but that his actual knowledge of the country, in that direction, did not embrace a circumference of more than five miles.

The line between the Chippewa and Sioux, as drawn on the MS. map of Neenaba, strikes the rapids on Red Cedar River at a brook and bluff a short distance below the mill. It proceeds thence, across the point of land between that branch of the main Chippewa, to an island in the latter; and thence, upstream, to the mouth of Clearwater River, as called for by the treaty, and from this point to the bluffs of the Mississippi Valley (where it corners on Winnebago land), on Black River, and not to the "mouth" of Black River, as erroneously inserted in the 5th article of the treaty; the Chippewas never having advanced any claims to the lands at the mouth of Black River. This map, being drawn by a Chippewa of sense, influence, and respectability, an exact copy of it is herewith forwarded for the use of the Department, as embracing the opinions of the Chippewas on this point. The lines and geographical marks were drawn on paper by Neenaba himself, and the names translated and written down by Mr. Johnston.

It is obvious that the adjustment of this line must precede a permanent peace on this part of the frontiers. The number of Chippewas particularly interested in it is, from my notes, 2,102; to which, 911 may be added for certain bands on Lake Superior. It embraces 27 villages, and the most influential civil and war chiefs of the region. The population is

enterprising and warlike. They have the means of subsistence in comparative abundance. They are increasing in numbers. They command a ready access to the Mississippi by water, and a ready return from it by land. Habits of association have taught them to look upon this stream as the theatre of war. Their young men are carried into it as the natural and almost only means of distinction. And it is in coincidence with all observation to say that they are now, as they were in the days of Captain Carver, the terror of the east bank of this river, between the St. Croix and Chippewa Rivers. No other tribe has now, or has had, within the memory of man, a village or permanent possession on this part of the shore. It is landed on in fear. It is often passed by other nations by stealth, and at night. Such is not an exaggerated picture. And with a knowledge of their geographical advantages, and numbers, and distribution, on the tributary streams, slight causes, it may be imagined, will often excite the young and thoughtless portion of them to raise the war-club, to chant the war-song, and follow the war-path.

To remove these causes, to teach them the folly of such a contest, to remind them of the treaty stipulations and promises solemnly made to the Government, and to the Sioux, and to induce them to renew those promises, and to act on fixed principles of political faith, were the primary objects committed to me; and they were certainly objects of exalted attainment, according as well with the character of the Government as with the spirit and moral and intellectual tone of the age. To these objects I have faithfully, as I believe, devoted the means at my command. And the Chippewas cannot, hereafter, err on the subject of their hostilities with the Sioux, without knowing that the error is disapproved by the American government, and that a continuance in it will be visited upon them in measures of severity.

Without indulging the expectation that my influence on the tour will have the effect to put an end to the spirit of predatory warfare, it may be asserted that this spirit has been checked and allayed; and that a state of feeling and reflection has been produced by it, which cannot fail to be beneficial to our relations with them, and to their relations with each other. The messages sent to the Sioux chiefs, may be anticipated to have resulted in restoring a perfect peace during the present fall and ensuing winter, and will thus leave to each party the undisturbed chase of their lands. The meditated blow of Steenaba was turned aside, and his war-party arrested and dispersed at the moment it was ready to proceed. Every argument was used to show them the folly and the insecurity of a continuance of the war. And the whole tenor and effect of my visit has been to inform and reform these remote bands. It has destroyed the charm of their seclusion. It has taught them that their conduct is under the supervision of the American government; that they depend on its care and protection; that no other government has power to regulate trade

and send traders among them; finally, that an adherence to foreign counsels, and to anti-pacific maxims, can be visited upon them in measures of coercion. That their country, hitherto deemed nearly inaccessible, can be penetrated and traversed by men and troops, with baggage and provisions, even in midsummer, when the waters are lowest; and that, in proportion as they comply with political maxims, as benevolent as they are just, will they live at peace with their enemies, and have the means of subsistence for an increased population among themselves. The conduct of the traders in this quarter, and the influence they have exerted, both moral and political, cannot here be entered upon, and must be left to some other occasion, together with statistical details and other branches of information not arising from particular instructions.

It may be said that the Indians upon the St. Croix and Chippewa Rivers, and their numerous branches, have been drawn into a close intercourse with Government. But it will be obvious that a perseverance in the system of official advice and restraints, is essential to give permanence to the effects already produced, and to secure a firm and lasting peace between them and the Sioux. To this end, the settlement of the line upon the Red Cedar Fork is an object which claims the attention of the Department; and would justify, in my opinion, the calling together the parties interested, at some convenient spot near the junction of the Red Cedar River with the Chippewa. Indeed, the handsome elevation, and the commanding geographical advantages of this spot, render it one which, I think, might be advantageously occupied as a military post. Such an occupancy would have the effect to keep the parties at peace; and the point of land, on which the work is proposed to be erected, might be purchased from the Sioux, together with such part of the disputed lands near the mills as might be deemed necessary to quiet the title of the Chippewas. By acquiring this portion of country for the purposes of military occupancy, the United States would be justified in punishing any murders committed upon it; and I am fully convinced that no measure which could, at this time, be adopted, would so certainly conduce to a permanent peace between the tribes. I therefore beg leave, through you, to submit these subjects to the consideration of the honorable the Secretary of War, with every distrust in my own powers of observation, and with a very full confidence in his.

I have the honor to be, sir,

Very respectfully, your obedient servant,

H. R. SCHOOLCRAFT.

To ELBERT HERRING, ESQ., Com. Ind. Affairs.

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APPENDIX C - Description of Georeferencing Transformations

Excerpt from *Understanding Raster Georeferencing* published by ESRI in 2018:

"Polynomial transformations use a polynomial built on control points and a least-squares fitting (LSF) algorithm. These transformations are optimized for global accuracy but do not guarantee local accuracy. Polynomial transformations yield two formulas: one for computing the output *x*-coordinate for an input (*x*,*y*) location and one for computing the *y*-coordinate for an input (*x*,*y*) location. The goal of the LSF algorithm is to derive a general formula that can be applied to all points, usually at the expense of slight movement of the two positions of the control points. The number of the noncorrelated control points required for this method must be one for a zero-order shift, three for a first-order, six for a second order, and ten for a third order. The lower-order polynomials tend to give a random type error, while higher-order polynomials tend to give an extrapolation error.

A zero-order polynomial is used to shift your data. This is commonly used when your data is already georeferenced, but a small shift will better line up your data. Only one control point is required to perform a zero-order polynomial shift. It may be a good idea to create a few control points, then choose the one that looks the most accurate.

The first-order polynomial transformation is commonly used to georeference an image. Use a first-order, or affine, transformation to shift, scale, and rotate a raster dataset. This generally results in straight lines on the raster dataset mapped as straight lines in the

warped raster dataset. Thus, squares and rectangles on the raster dataset are commonly changed into parallelograms of arbitrary scaling and angle orientation.

With a minimum of three control points, the mathematical equation used with a first-order transformation can exactly map each raster point to the target location. Any more than three control points introduces errors (or residuals) that are distributed throughout all the control points. However, you should add more than three control points, because if one control is inaccurate, it has a much greater impact on the transformation. Thus, even though the mathematical transformation error may increase as you create more links, the overall accuracy of the transformation will increase.

The higher the transformation order, the more complex the distortion that can be corrected, but transformations higher than third order are rarely needed. Higher-order transformations require more links and will involve progressively more processing time. In general, if the raster needs to be stretched, scaled, and rotated, use a first-order transformation. If the raster dataset must be bent or curved, use a second- or third-order transformation."

Excerpt from *Test Georeferencing Transformations* (Price, 2018):

"The Similarity Polynomial, a first-order transformation, requires a minimum of three points. It tries to preserve the shape of the original raster, so the overall rectangular shape of EV_004 is preserved but the internal error is typically higher than other polynomial

transformations since the preservation of shape is more important than the best fit. The Forward-Inverse Error is zero."

"Requiring at least three points, this transformation is optimized for both global least-squares fitting (LSF) and local accuracy. It combines a polynomial transformation with a triangulated irregular network (TIN) interpolation. The Adjust transformation performs a polynomial transformation using two sets of control points and adjusts the control points locally to better match the target control points using a TIN interpolation technique."

"The Projective transformation can warp lines so that they remain straight, so lines that were once parallel may not remain parallel. This transformation is especially useful for oblique imagery, scanned maps, and some imagery products such as Landsat and DigitalGlobe. A minimum of four links are required to perform a Projective transformation. When only four links are used, the RMS error will be zero. When more points are used, the RMS error will be slightly above zero."

"Spline transformation is a true rubber sheeting method that is optimized for local but not global accuracy. It is based on a spline function, a piecewise polynomial that maintains continuity and smoothness between adjacent polynomials. Spline transforms the source control points exactly to target control points, so error is minimal. Pixels that are a distance from the control points are not guaranteed to be accurate. This transformation is useful when the control points are important, so those control points must be registered precisely. A spline transformation requires a minimum of 10 points."