Simmons University
Improving Digital Inclusion and Broadband Infrastructure in Native Communities

Simmons University, together with the Association of Tribal Archives, Libraries, and Museums (ATALM), is requesting $517,078 to fund a 2-year National Leadership Grant for Libraries project, titled "Improving Digital Inclusion and Broadband Infrastructure in Native Communities." The research in service to practice seeks to address a gap in the library and information science literature by pursuing the following research question: *Guided by Indigenous ways of knowing about technology and an affirmation of tribal sovereignty, how can a participatory community informatics approach address the digital inclusion needs and aspirations of tribal libraries?* Five participating tribal libraries from across Indian Country will work with the research team to co-design three deliverables: (1) an update to ATALM's 2014 report "Digital Inclusion in Native Communities: The Role of Tribal Libraries," (2) a Digital Inclusion Lab "How-To Guide," which will provide substantive, co-authored instructional material that can be used throughout Indian Country, and (3) a final report with lessons learned and best practices from our participatory community informatics research project. The research will also gather data from our open-source broadband measurement system in each of the five tribal libraries, which has the potential to inform the Federal Communication Commission's (FCC) E-Rate program and other national policies aimed at improving digital inclusion and broadband infrastructure in tribal libraries.

Statement of National Need

"It is important to approach Indigenous digital endeavors as creative efforts to apply tools and techniques to addressing local needs and establishing a direction into a locally imagined future"
- Marisa Elena Duarte, *Network Sovereignty: Building The Internet Across Indian Country*

The proposed research in service to practice will both address a nationally significant challenge, regarding the digital inclusion and broadband infrastructure needs of tribal libraries, and pursue an important opportunity to support the sovereignty, self-determination, and self-governance of Native communities. As a participatory community informatics project, guided and informed by Indigenous ways of knowing about information and communication technology (ICT), the needs for this research project were identified by ATALM in their report, "Digital Inclusion in Native Communities: The Role of Tribal Libraries" (Jorgensen, Morris, & Feller, 2014). The 2014 ATALM report presents findings from a national needs assessment survey conducted by ATALM and funded by IMLS (award #RE-56-13-0080-13). Results from the report provide a stark contrast between the percentage of public libraries that provide their communities with access to computers, Internet, and digital literacy training and tribal libraries that provide these same services. For example, while 100 percent of public libraries in the 2011-2012 Public Library Funding and Technology Access Survey offered public Internet access to their patrons, only 68 percent of tribal libraries in ATALM's study reported providing free public Wi-Fi that patrons with personal laptops or wireless devices could use to access the Internet (p. 7). In ATALM's 2014 report, only 50 percent of tribal librarians reported that their libraries' Internet connections were either "very good" or "extremely good," and only 15% of tribal library Internet connection speeds were reported at 100 Mbps or greater (p. 14). In terms of digital literacy training, more than 80 percent of respondents in ATALM's study reported that it was either "extremely important" or "important" to provide access to online and in-library digital literacy training. However, only 58 percent of the respondents reported that they offered digital literacy training of any type.

The top three priorities that resulted from ATALM's survey included the following: (1) more funding for updated equipment and software; (2) faster and more reliable/affordable broadband connections; (3)

training for staff and patrons (p. 25). In response, the report called for five key action areas relating to 1) leadership, 2) training, 3) resources and services, 4) policy and advocacy, and 5) research.

Over the past six years, ATALM has worked diligently to address the training needs of tribal librarians, provide leadership in the field, and address digital inclusion policy issues. For example, ATALM worked with New Mexico Senator Martin Heinrich as he launched the "Bridging the Tribal Digital Divide Act"[1] and called the FCC's attention to the need to find ways around the E-Rate barriers in enabling tribal libraries to access E-Rate funding. While much progress has been made in addressing the recommendations in the plan, a lack of funding has proved to be an impediment. With new support from funders such as the Doris Duke Charitable Foundation and the Native Nations Institute at the University of Arizona, ATALM is rededicating its effort to providing the support tribal libraries need. Crucial to the efforts is the research and demonstration programs proposed herein.

Our proposed research also seeks to address a gap in the library and information science (LIS) literature on the digital inclusion and broadband infrastructure needs of tribal communities. While decades of research from both Indigenous and non-Indigenous scholars has documented the important role of tribal libraries in serving their communities' information and technology needs (e.g. see Biggs & Whitehorse, 1995; Dorr & Akeroyd, 2001; Duarte, 2017; Patterson, 2000; Roy, Bhasin, & Arriaga, 2011), there remains scant evidence in the LIS literature of the digital inclusion needs and aspirations among tribal librarians and their communities. In addition to updating ATALM's 2014 report with new numbers, our proposed research in service to practice represents an opportunity to complement and build upon existing theory, scholarship, and practice in the field. Other than ATALM's 2014 report, and more recent work by Duarte (2017) outlining the important role of tribal libraries in promoting digital inclusion and broadband infrastructure in Indian Country, there are few current studies available to assist tribal librarians, researchers, and policymakers in understanding the current digital inclusion and broadband infrastructure needs of tribal libraries.

Project Design

Research Questions

The proposed research in service to practice will respond to the digital needs and aspirations of tribal libraries in five locations across Indian Country through the following research question:

- **Core Research Question**: *Guided by Indigenous ways of knowing about technology and an affirmation of tribal sovereignty, how can a participatory community informatics approach address the digital inclusion needs and aspirations of tribal libraries?*

Our research will also pursue the following additional research questions:

R1. What are the sociotechnical characteristics of tribal library network infrastructures, including the ways in which ICTs are socially shaped by interconnected individuals, communities, devices, policies, institutions, and systems?

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[1] https://www.congress.gov/bill/116th-congress/senate-bill/3264?q=%7B%22search%22%3A%5B%22S.+84%22%5D%7D&r=5&s=1

R2. How can tribal librarians and community informatics researchers co-design a "Digital Inclusion Lab" model for tribal libraries in other communities across Indian Country?

R3. How can open-source tools be employed to help tribal librarians better understand the speed and quality of service of their library's broadband internet connections?

R4. How can tribal librarians and community informatics researchers co-design culturally relevant digital literacy training, using both digital and non-digital strategies, to support the sovereignty, self-determination, and self-governance of their communities?

The research will build on findings from ATALM's 2014 report, along with the following additional IMLS-funded projects: (1) Internet2's "Toward Gigabit Libraries" toolkit;[2] (2) "At the Edges of the National Digital Platform: Rural Library Hotspot Lending Programs" research project,[3] and (3) "Measuring Library Broadband Networks for the National Digital Platform"[4] led by Simmons University with M-Lab and Internet2 to develop a broadband measurement platform with and for public libraries across the U.S.

Conceptual Framing

The research will be grounded in conceptual frameworks developed by Indigenous and non-Indigenous scholars who have rooted their approach to studying information and communication technology (ICT) as sociotechnical systems inseparable from the histories of (de)colonization, sovereignty, and self-determination of Native peoples. The research team will both build upon and contribute to the following two conceptual frameworks: Network Sovereignty (Duarte, 2017) and Community Informatics (Gurstein, 2003; Rhinesmith, 2019). These two frameworks bridge the gap between digital inclusion and the needs of tribal libraries.

Network Sovereignty was conceptualized by Dr. Marisa Elena Duarte (Pascua/Yaqui) most prominently in her 2017 book of the same name. This Indigenous research strategy places ICTs in the context of (de)colonization, self-determination, and Indigenous sovereignty. Duarte argues that ultimately tribal control over ICT facilitates their ability to care for the wellbeing of their waters, lands, peoples, and cultures. This is visible, for example, in several participating libraries' use of technology as part of language revitalization programs. The need for Network Sovereignty has also been made plain in light of the COVID-19 pandemic. Core to our research as well as the Network Sovereignty principle that ICTs must be recognized as *sociotechnical systems*. This means that the computers, software, and broadband infrastructure that support staff and patron use in tribal libraries must be thought of as part of a broader web of interconnected and interdependent social, political, and cultural relationships fraught with both historical struggle and future possibility.

Community informatics (CI) has been described as the use of ICT to support community-defined development goals (Rhinesmith, 2019). It is both a field of research and practice that draws upon a number of diverse disciplines, including library and information science, social work, urban planning, rural sociology, public policy, among other areas. CI has been selected as the second conceptual framing for our study because it has been proven to be an effective participatory approach to conducting research with Indigenous communities based on first "building a relationship based on mutual trust and respect" (Beaton,

[2] https://internet2.edu/community/community-anchor-program/cap-library-resources/toward-gigabit-libraries/
[3] https://texastipi.org/project/imls-rural-hotspots-2/
[4] https://slis.simmons.edu/blogs/mlbn/

O'Donnell, Fiser, and Walmark, 2009). CI has also been identified that great care and ongoing assessments are needed in community-university partnerships "in order to (a) ensure that engagement does not reinforce existing race, class, and gender inequalities, and to (b) reduce the potential of causing any harm in community settings." (Rhinesmith & Wolske, 2015).

Research Design

Transformative research and evaluation (Mertens, 2009) will be used during each step of the research process, including the protocol design, data collection, analysis, and reporting stages. We believe this participatory approach is complementary to our conceptual framing, particularly Duarte's (2017) Network Sovereignty approach to understanding digital inclusion and broadband infrastructure in tribal communities. This is because, as Mertens (2009) explains, "The need for transformative research and evaluation is supported by examples of inequities in access to culturally appropriate services for people who are pushed to the margins of society" while at the same time "deficit perspectives of marginalized communities are challenged by focusing on resilience in such communities and examining sample research studies that are based on transformative principles" (p. 9). Our research team will use this transformative, participatory, and asset-based approach to data collection and analysis during all four phases during the 2-year grant period.

- **Phase 1** will begin on August 1, 2021. ATALM will recruit a National Tribal Library Broadband Council (NTLBC) to advise on the project, provide training, and continue to lead new initiatives after the proposed project ends. This phase will also include Indigenous researchers at the Native Nations Institute who will work with the research team in the CI Lab at Simmons to co-design the survey for tribal librarians based on the questionnaire used to collect data for ATALM's 2014 report. As the authors wrote, "The data collected create the needed raw material for tribal libraries to participate meaningfully in policy discussions and are a baseline for measuring progress" (Jorgensen, Morris, & Feller, 2014, p. 1). In this way, we hope that the 2014 will serve as the baseline for our research, while including additional questions in our protocol to understand both the impacts of COVID-19 on the digital inclusion needs and aspirations of tribal libraries, as well as how progress has hopefully been made since the 2014 report was published. The CI Lab will work closely with the Native Nations Institute to analyze the data and report the research findings. At the Digital Inclusion Summit during the ATALM conference in 2021, participants will review the findings of the survey and the preliminary recommended actions. Participants will include tribal librarians, funders, government officials, and other stakeholders. Participant feedback will be included in the final report.

- **Phase 2** will begin on February 1, 2022. During this phase, we will publish the report from our 2021 survey, which will provide information on the libraries in the following key areas: technology offered; digital capacities and needs, Internet use; further opportunities to improve digital inclusion and broadband infrastructure; among other key areas identified in our report. These findings will help us to determine the hardware, software, broadband measurement, and digital literacy needs in each of the tribal libraries. ATALM will also work with Simmons, the NTLBC and other project partners/consultants to develop a project website that links to training and resources, as well as updates in the field.The CI Lab at Simmons University worked with ATALM to identify the following

tribal libraries[5] as both research sites and community partners for our study. The research team in the CI Lab will use findings from this report to gain a better understanding of the current digital inclusion needs and aspirations of the five tribal libraries that we will work with for our study (see Table 1). During this phase, the research team will also gather additional qualitative data through interviews with tribal librarians, network administrators, and patrons, as well as through our fieldwork at each library, while keeping in mind COVID-19 precautions, contingencies based on these precautions, as well as variances in vaccine rollout.

Table 1. Participating Tribal Libraries

Name of Library	Location	Percent of Population with Wired Broadband[6]	Percent of Population with Affordable Broadband[7]	Additional Information
White Mesa Library	Ute Mountain Ute Tribe land; Utah	32%	32%	Builds on IMLS Native American Library Services: Basic Grants
Kooyooe Tukadu Language, Culture, and Library Program	Pyramid Lake Paiute Land; Nevada	99%	41%	Builds on a 2018 IMLS Enhancement Grant (NG-03-18-0185-18) to support language revitalization
Yakama Tribal Library	Confederated Tribes of the Yakama Nation land; Washington	67%	1%	Builds on several IMLS grants, most notably a 2018 Native American Library Service: Enhancement Grant to provide Bookmobile services, including mobile computer access.
Fort McDowell Tribal Library	Fort McDowell Yavapai Nation; Arizona	95%	0%	Builds on 2020 (NAB-246643-OLS-20) and 2019 (NG-01-19-0171-19) IMLS Native American Library Services Basic Grants for a Native language focused digital database
Quapaw Tribal Library	Quapaw Nation; Oklahoma	91%	38%	Builds on 2013 IMLS Enhancement Grant (NG-03-13-0028-13) to provide programming related to Quapaw culture and greatly expand e-resources

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[5] **A Note on Library Selection**: Many of these libraries have received grant funding before. While we believe this is an asset in and of itself, this is also because grants often provide money for the necessary infrastructure to make a project like ours possible in Indian Country (in fact, ATALM's 2014 Digital Inclusion Report found that 16% of tribal libraries in their sample relied on IMLS as the sole source of their funding (Jorgensen, Morris, & Feller, 2014, p. V)). Selected libraries all have some degree of broadband connectivity and accessible computers, which was a prerequisite for developing our "Digital Inclusion Lab" model. These libraries still have a wide array of differences in connectivity, population, culture, and other important factors to ensure diversity in our research findings. While we would like to work on a project supporting tribes who are looking to establish their own broadband networks, that is beyond the scope and financial capabilities of this project. Nevertheless, we will include recommendations for libraries with less (and more) connectivity in our How-To Guide.

[6] (Tanberk and Cooper, 2020)

[7] Ibid.

During Phase 2, the research team will also work with a tribal library consultant who will help to install the hardware, software, and the open source broadband measurement system in each of the five libraries to assist the tribal librarians and their communities with gaining access to the speeds and quality of service of their broadband internet connections. The data can also be used to provide a snapshot of the status of broadband connectivity in tribal libraries across Indian Country, which ATALM has identified as data lacking in national studies.

ATALM will lead a series of virtual meetings with the five partner tribal libraries to help inform the development of digital literacy training materials and programs. A Network Sovereignty (Duarte, 2017) framing will carefully guide this stage of the research, particularly to inform how we work with each tribal library to understand the unique histories of the tribes, their libraries, and their patrons. The quantitative data gathered through the broadband measurement platform for each of the libraries will be analyzed by our team using data and statistical analysis tools. The team will also have the ability to export the data for statistical analysis in an outside software platform, such as SPSS.

ATALM will work with Simmons University, Native Nations Institute, and tribal communities to develop and test model digital inclusion labs in five tribal libraries. The research team in the CI Lab will share findings from the qualitative and quantitative analysis with the five tribal libraries to gain their further insights. This co-design process will help the research team to develop a "Digital Inclusion Lab" model for tribal libraries across Indian Country. This model will provide information on the hardware, software, broadband measurement, and digital literacy needs of tribal libraries. The model is not meant to be reductionist. Rather, we will work to make sure that the lab model is adaptable to reflect the unique needs and aspirations of each tribal library and their community. This model will serve as the foundation and structure for our Digital Inclusion "How-To Guide" for Tribal Libraries, which is the second major deliverable for our research in service to practice.

- **Phase 3** will begin on August 1, 2022 and focus primarily on co-developing our Digital Inclusion Lab "How-To Guide" for Tribal Libraries. As mentioned above, the guide will use findings from our participatory community informatics project with our five tribal libraries, as well as data from the two previous phases, to develop the guide. The purpose of the guide is to assist other tribal librarians in creating a digital lab with and for their communities across Indian Country. The guide will also help our team to scale and replicate the lessons learned from our research in service to practice. The How-To Guide will include the hardware, software, and broadband infrastructure specifications needed for other tribal libraries to create their digital inclusion labs, including instructions about how to install the open source broadband measurement system and to co-develop digital literacy training materials *with* and *for* their communities. We will publish a public version of the "How-To Guide" that can be used by any tribal library.

- **Phase 4** will begin on February 1, 2023 and shift significantly to focus on our final data analysis and reporting. The qualitative data gathered from our interviews and fieldwork visits with the five tribal libraries will be transcribed and uploaded as files into Dedoose for analysis. The researchers will use this software platform to code the data and develop themes for our analysis, using guidance from Saldaña (2016). The goal for our analysis will be to use our theoretical framework to guide how we look at both the quantitative and qualitative data, including being able to "triangulate" (Stake, 1995) multiple perspectives from tribal library staff, network administrators, and patrons.

The findings from this phase, as well as the other three phases, will be considered for the publication of our final report, which is the major deliverable during this final phase of the project. The report will also include lessons learned and best practices from our participatory community informatics research in service to practice.

All four stages of the research will require Institutional Review Board (IRB) approval, which our team will take steps to secure after the grant has been awarded to Simmons University. The research will use findings from our Phase 1 survey for practitioners to ensure that our work is informed by current practice. We believe the findings from the research will have the potential to further professional practice both through the survey results, as well as through the lessons learned, best practices, and our Digital Inclusion Lab "How-To Guide" for Tribal Libraries that will be developed through our deep engagement with the five tribal libraries that will participate in this project.

The research team in the CI Lab and ATALM will translate and publicly share research findings for practitioners during ATALM's annual conference and at other conference venues where tribal librarians and network administrators convene. As we described above, we believe the chosen research methods are adequate and appropriate to answer the research questions because of the connection between our use of Mertens' (2009) transformative research and evaluation approach, Duarte's (2017) Network Sovereignty framing and our participatory community informatics approach (Rhinesmith, 2019). We will use community informatics as a research and practical strategy to ensure that the research methods are applied in an effective and culturally appropriate way, building on previous CI studies with Indigenous communities (Beaton, O'Donnell, Fiser, and Walmark, 2009). The feasibility and applicability of various approaches were considered in this project design by emphasizing the role of Simmons University's community partner, ATALM, and their interests in working together on this project. Since the two teams first talked about the project, and began working together, we have worked to make sure that the project is mutually beneficial and is grounded in and informed by the past work of both project teams. The conceptual and methodological frameworks chosen for this project explicitly emphasize this participatory and collaborative approach in all steps of the research design.

The participatory research methods will assist us in producing generalizable findings, while also making sure to effectively communicate the unique and special histories and cultures of each tribal library and their communities involved with this project. Our "How-To Guide" will focus on making sure that our recommendations, based on our research findings, are generalizable to a community of tribal libraries across Indian Country who we will benefit from this resource. The research questions will also be appropriately constructed to successfully frame the project design, data collection, interpretation, and other aspects of the research process. This is because we are using a participatory community informatics research design that has been and will continue to be informed by the participants, partners, and our advisory board members.

Project Goals

Findings from the research will be used to co-design the following three main deliverables together with five tribal libraries that will participate in the project: (1) an update to ATALM's 2014 report "Digital Inclusion in Native Communities: The Role of Tribal Libraries," (2) a Digital Inclusion Lab "How-To Guide," which will provide specifications on the hardware, software, broadband measurement, and digital literacy needs of tribal libraries, and (3) a final report with lessons learned and best practices from our participatory community informatics research in service to practice. The project will also provide data from our open

source broadband measurement system in each of the five tribal libraries, which may have implications for the Federal Communication Commission's (FCC) E-Rate program and other national programs aimed at improving digital inclusion in tribal libraries across Indian Country.

Our project team will ensure project success and national impact through engaging with many collaborators, including our five tribal libraries, as well as advisory board members who will have expertise in a range of issues related to the social, cultural, and technical needs of tribal libraries and their communities. The target community for the project are tribal librarians, who will contribute their perspectives into each phase of our project. Because we are using a transformative research and design approach informed by participatory community informatics and Indigenous ways of knowing about ICTs in tribal communities, external input, validation, and consensus building is a foundational part of our project.

Performance Goals and Indicators of Success

Our proposed research in service to practice seeks to support the IMLS goal to promote "museums and libraries as strong community anchors that enhance civic engagement, cultural opportunities, and economic vitality."[8] More concretely, our project will promote National Digital Infrastructures and Initiatives by helping tribal communities to enhance information literacy and digital inclusion efforts through expanded broadband connectivity and innovative collaborations. Indicators of success for our project overall include creating an innovative and culturally relevant "Digital Inclusion Lab" model in a way that is both validated by our five tribal library partners and adaptable to other tribal libraries across Indian Country. Through the participatory design of this project, tribal libraries will be able to provide immediate feedback to help us to know whether the Digital Inclusion Lab model is successful. In addition to updating the 2014 ATALM report, we will also have a final evaluation where we will ask our participants to describe their perceptions on the efficacy of the Digital Inclusion Lab in their library, as well as the utility of the How-To Guide. We hope that constant, ongoing engagement with the community partners will help us to adapt our project's design or the outcomes of our work to reflect the evaluation results over the course of the period of performance. The main deliverables from the research project will be presented during annual ATALM conferences, where we will receive additional feedback from practicing tribal librarians. We will also create a final report, which will be submitted to IMLS at the end of the project and shared with each of the tribal libraries. The findings should also be useful to other Native communities, state library agencies, and federal agencies interested in strengthening tribal libraries as leaders in digital inclusion across Native America.

Diversity Statement

Diversity and equity are not tacked on to this proposal; they are foundational to its very existence. Fundamentally, this project is about bridging an equity gap between tribal and non-tribal public libraries' digital access and broader implications for the communities they serve. Following the Network Sovereignty framework, our work affirms and supports tribal sovereignty, a core component of Indigenous self-determination. Because of long histories of colonization and marginalization, tribal libraries are often ignored in discussions of both digital equity and public libraries. When they are mentioned, tribal libraries and the communities they serve are often treated as monolithic. This project underscores the importance of tribal, library, and community diversity by incorporating it into every aspect of the process, from library selection to the How-To Guide design and beyond.

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[8] https://www.imls.gov/sites/default/files/publications/documents/strategicplan2012-16_brochure.pdf

The project will include a diversity of perspectives by incorporating the experiences, insights, and aspirations of tribal librarians and their communities in five different locations across Indian Country. As a participatory research project, the design of our work must involve the participants and communities in defining the challenges and opportunities as well as creating and implementing the project. This work has already begun, as we have established the project's design in collaboration between the CI Lab at Simmons University and ATALM, who have been in partnership for the past six years. We will continue this collaboration and engagement with tribal libraries throughout each of the four phases of our research project.

National Impact

The research in service to practice will positively impact tribal libraries and their communities in three significant ways. First, the digital inclusion survey will provide updated data on broadband connectivity in tribal libraries, which are often left out of national surveys. The resulting publication and action items will help keep the momentum generated by this project moving forward. The 2014 study served as a catalyst for significant change and it is anticipated that the 2021 study will have a similar national impact.

Second, our Digital Inclusion Lab model will generate systemic change throughout Native America. The "How-to Guide" and other resources generated as a part of the project will be available to tribal libraries of all sizes, as well as small public libraries that don't have the expertise to develop viable technology centers. The Guide will provide specifications to assist other tribal and public libraries in implementing the Digital Inclusion Lab model, which will include details about the appropriate hardware, software, and broadband infrastructure needed to support a range of digital services and digital literacy training programs. The Guide will help librarians learn how to implement the open source broadband measurement system. The purpose of the Guide is ultimately intended to help ensure that these project deliverables are readily adaptable and usable by other institutions and communities across Indian Country and rural America.

Third, the program could have implications for national policymaking and funding for tribal libraries. Despite the fact that tribal libraries and tribal communities are by far the statistically least connected to broadband, only 15% of tribal libraries receive E-Rate funding (Jorgensen, Morris, & Feller, 2014, p. V). By providing the needed hard data on use and bandwidth, our broadband measurement platform can help tribal libraries secure this funding. The research could also help support passage of the "Tribal Connect Act,"[9] a bipartisan bill in the Senate that would increase E-Rate eligibility and create funding to bridge the digital divide.

Land Acknowledgement

Simmons University is situated on the traditional, unceded land of the Nipmuc, Wampanoag, Pawtucket, and Massachusett Tribes, who have been here since time immemorial. We particularly want to note that Simmons University benefits from the genocide, ethnocide, land theft, and colonization started in this area by English settlers over 400 years ago that continues to this day. Our work with Indigenous communities on this project is one small step toward addressing greater injustices across Native America. We are

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[9] https://www.congress.gov/bill/116th-congress/house-bill/7973

grateful for the opportunity to work with Indigenous people on this project--work which must continue long after this project is completed.

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Improving Digital Inclusion and Broadband Infrastructure for Tribal Libraries
Schedule of Completion

Task	Phase 1 - 2021-2022						Phase 2 - 2022						Phase 3 - 2022-2023						Phase 4 - 2023					
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Task 1: Develop questionnaire for tribal libraries survey	█	█																						
Task 2: Recruit tribal library participants to complete the survey		█	█																					
Task 3: Collect survey data from participants			█	█																				
Task 4: Analyze survey data				█	█	█																		
Task 5: Share findings with tribal libraries for review and feedback				█	█	█																		
Task 6: Finalize list of Advisory Council (NTLBC) members				█	█	█																		
Task 7: Conference call with NTLBC members						□																		
Task 8: Create draft 2021 Tribal Library Digital Inclusion Report							█	█																
Task 9: Share draft report with NTLBC and tribal libraries								█																
Task 10: **Publish 2021 Tribal Library Digital Inclusion Report**									△															
Task 11: Begin work with tribal library consultant									█	█														
Task 12: Upgrade hardware, software in six tribal libraries									█	█														
Task 13: Install broadband measurement devices with tribal libraries										█														
Task 14: Conduct interviews with tribal librarians, network administrators, and patrons at each tribal library										█	█													
Task 15: Co-design digital literacy training with tribal librarians											█	█												
Task 16: Co-develop Digital Inclusion Lab model with libraries											█	□	█											
Task 17: Begin developing Digital Inclusion Lab How-To Guide													█	█	█									
Task 18: Share initial draft of the How-To guide with NTLBC and libraries															█	█	█							
Task 19: Use feedback from NTLBC and librarians to make edits															█	█	█							
Task 20: Create draft version of How-To Guide															█	█	█							
Task 21: **Publish Digital Inclusion Lab How-To Guide for Tribal Libraries**																		△						
Task 22: Conference call with NTLBC members																		□						
Task 23: Continue analyzing qualitative and quantitative data																			█					
Task 24: Share initial findings from analysis with tribal libraries																				█				
Task 25: Use feedback to begin drafting final report for IMLS																				█	█			
Task 26: Draft final report on the research for NTLBC feedback																				█	█			
Task 27: Revise final report draft based on feedback																					█	█	█	
Task 28: Publish research findings with ATALM and tribal libraries as co-authors in academic journals & practitioner conferences																			█	█	█	█		
Task 29: **Submit the final report to IMLS**																								△
Task 30: Final conference call with NTLBC members																								█

□ = milestone   △ = deliverable

<div align="center">**DIGITAL PRODUCT FORM**</div>

Introduction

The Institute of Museum and Library Services (IMLS) is committed to expanding public access to federally funded digital products (i.e., digital content, resources, assets, software, and datasets). The products you create with IMLS funding require careful stewardship to protect and enhance their value, and they should be freely and readily available for use and re-use by libraries, archives, museums, and the public. However, applying these principles to the development and management of digital products can be challenging. Because technology is dynamic and because we do not want to inhibit innovation, we do not want to prescribe set standards and practices that could become quickly outdated. Instead, we ask that you answer questions that address specific aspects of creating and managing digital products. Like all components of your IMLS application, your answers will be used by IMLS staff and by expert peer reviewers to evaluate your application, and they will be important in determining whether your project will be funded.

Instructions

You must provide answers to the questions in Part I. In addition, you must also complete at least one of the subsequent sections. If you intend to create or collect digital content, resources, or assets, complete Part II. If you intend to develop software, complete Part III. If you intend to create a dataset, complete Part IV.

PART I: Intellectual Property Rights and Permissions

A. Creating or Collecting New Digital Content, Resources, or Assets

A.1 What will be the intellectual property status of the digital products (content, resources, assets, software, or datasets) you intend to create? Who will hold the copyright(s)? How will you explain property rights and permissions to potential users (for example, by assigning a non-restrictive license such as BSD, GNU, MIT, or Creative Commons to the product)?
Explain and justify your licensing selections.

Software produced under this program will build upon work developed during our previous IMLS grant, titled "Measuring Library Broadband Networks for the National Digital Platform," (award #LG-71-18-0110-18). The software for this project will also be assigned an MIT license, as is consistent with other software produced by Measurement Lab. The MIT licence is a permissive license that places only limited restriction on reuse. Data produced using M-Lab tools integrated into the software will be licensed using the Creative Commons Zero license, consistent with M-Lab's licensing practice for data produced by tests running on the M-Lab platform. Content and other digital products produced by the program will be licensed using the Creative Commons Attribution-Noncommercial-Share-Alike 4.0 license which allows reuse with attribution for noncommercial use. Copyrights for software produced will be held by the Measurement Lab

project at Code for Science and Society, Inc.

A.2 What ownership rights will your organization assert over the new digital products and what conditions will you impose on access and use? Explain and justify any terms of access and conditions of use and detail how you will notify potential users about relevant terms or conditions.

As with our previous IMLS grant (see above), Measurement Lab will also retain ownership rights for the broadband measurement software and products used in this program, but will not impose any restrictions on access and use, consistent with the attribution requirement for reuse of content or resources licensed under the Creative Commons 4.0 license, and the terms of re-use within the MIT license agreement.

A.3 If you will create any products that may involve privacy concerns, require obtaining permissions or rights, or raise any cultural sensitivities, describe the issues and how you plan to address them.

In some jurisdictions, the IP address assigned to a customer premise device (CPE) is considered personally identifiable information (PII). Internet measurement tests used by the software produced do collect this IP address. M-Lab provides provision in its Privacy Policy for users who wish to have their results anonymized or removed from its public dataset. The software does allow for results including IP address to be collected by the entity using the software, and to save those results on private infrastructure. Therefore the entity using this software will be considered the holder of that data, and would need to address any potential PII issues in their own policies. No other data except IP address is collected that would require permission or rights, or which would raise cultural sensitivities. Any concerns regarding privacy will be documented.

Part II: Projects Creating or Collecting Digital Content, Resources, or Assets

A. Creating or Collecting New Digital Content, Resources, or Assets

A.1 Describe the digital content, resources, or assets you will create or collect, the quantities of each type, and format you will use.

The research team will utilize M-Lab's internet measurement and data visualization platform, consisting of open source software running on recommended measurement devices, which leverages the Measurement Lab platform and tools. The system will also make use of non-M-Lab and non-open source tests such as Ookla. M-Lab will also contribute to documentation of this platform, such that it could be replicated by individuals, libraries, etc.; and to generally broaden understanding of internet/broadband measurement in the tribal library community.

Data produced by M-Lab measurement tests from devices placed in the five tribal libraries for this research project will be submitted to M-Lab, but also will be maintained as a separate dataset in the data collection and visualization system mentioned above. The specific tests

employed on the measurement devices as well as the resulting data the tests produce, will be determined iteratively with input from our stakeholders, but is likely to include the Network Diagnostic Tool (NDT), Neubot, and other tests supported by M-Lab. The amount of data gathered by each test in the measurement system will be variable according to the number of tests, devices, the frequency each test is scheduled to run, and the length of time in which data is collected. Test data will be stored in perpetuity by M-Lab. Data produced by non-M-Lab tests will be submitted to the test provider, per their policies, and will be retained in a private dataset to be used in analyses and publications.

Each of the five tribal libraries will have access to the broadband measurement data and retain ownership of the data, as well. Any of the other documentation in digital form produced by the project will also be co-owned with ATALM and the five participating tribal libraries. Digital content in the form of documentation will be available in standard formats, but will also be adapted as relevant to the community of interest. The first stage of the project will involve a meeting of tribal library stakeholders at the ATALM Annual Meeting, where the project team will identify the formats or documentation platforms to use for digital assets.

A.2 List the equipment, software, and supplies that you will use to create the content, resources, or assets, or the name of the service provider that will perform the work.

The broadband measurement data gathered at each tribal library through this research project will use M-Lab's internal computing resources to create content, resources, or assets. M-Lab will leverage services provided by Balena.io, a platform as a service company which provides remote management and administration of these types of computing devices. Hosting of server side components of this system will be provided for the grant term by virtual machines in the Google Cloud Platform, or Linode. Server side components will be developed such that they can be re-deployed via standard virtualization tools such as Docker, and hosted on the cloud or local infrastructure of choice to future users.

A.3 List all the digital file formats (e.g., XML, TIFF, MPEG) you plan to use, along with the relevant information about the appropriate quality standards (e.g., resolution, sampling rate, or pixel dimensions).

We will use digital file formats and specifications based on the needs identified by in consultation with ATALM and our tribal library stakeholders in stage 1 of the project.

B. Workflow and Asset Maintenance/Preservation

B.1 Describe your quality control plan (i.e., how you will monitor and evaluate your workflow and products).

The broadband measurement data collected for each tribal library during this research project will follow M-Lab's rigorous quality control protocol during development of all software. A new project typically begins as an idea, which is discussed by the team. If a decision is made to

move forward, a design document is produced and discussed. Once a project is approved for development, all coding is done in a developer's fork or in a feature branch, and submitted to at least one other team member for code review. Reviewers must provide approval before any code is merged into a master or production branch. M-Lab also builds quality control into the development process itself by using integration tests and commit hooks, which test the code for stylistic compliance. M-Lab also leverages continuous integration testing from Travis-ci.com on each commit and/or pull request. Lastly, software releases are tested on a set of hardware devices prior to any production roll out. M-Lab maintains a testbed of M-Lab server(s) and sample clients running on various hardware types, as well as an inventory of measurement devices that will be used in this research, so any part of the measurement system can be tested independently or concurrently, in a separate, offline environment.

B.2 Describe your plan for preserving and maintaining digital assets during and after the award period of performance. Your plan may address storage systems, shared repositories, technical documentation, migration planning, and commitment of organizational funding for these purposes. Please note: You may charge the federal award before closeout for the costs of publication or sharing of research results if the costs are not incurred during the period of performance of the federal award (see 2 C.F.R. § 200.461).

All code developed during this project related to the broadband measurement system in each tribal library will be hosted in shared Github repositories. Any other relevant digital assets will also be saved in a Github repository, such as technical documentation, toolkit resources, images, and final published documents. M-Lab is committed to using its organizational capacity to host these resources through our Github account. They are also open to hosting these resources elsewhere should project partners desire alternative or additional platforms or storage locations. M-Lab will utilize cloud computing resources, such as virtual servers on Google Cloud Services, to host data and visualization components specific to this project. Measurement test data will be stored on this cloud computing platform at least for the duration of this research project. All data collected by the project and the measurement system will be archived as a function of our final report, provided to participating libraries, and made available in perpetuity on an archiving platform to be recommended by our advisory group and/or principal investigator. The final set of collected data will be hosted on Github.

C. Metadata

C.1 Describe how you will produce any and all technical, descriptive, administrative, or preservation metadata. Specify which standards you will use for the metadata structure (e.g., MARC, Dublin Core, Encoded Archival Description, PBCore, PREMIS) and metadata content (e.g., thesauri).

All project related files, reports, and links to data and code will be created within the open access platform, Harvard Dataverse following the metadata structures advised by the platform.

C.2 Explain your strategy for preserving and maintaining metadata created or collected during and after the award period of performance.

We will work closely with ATALM and the five tribal libraries to preserve and maintain the metadata created or collected during and after the award period of performance. We will use the Harvard Dataverse project for this work in consultation with ATALM and the tribal libraries. If ATALM and the tribal libraries decide they want to use another strategy for preserving and maintaining metadata created or collected during and after the award period of performance, then we will follow their lead in determining the most culturally appropriate means to do so.

C.3 Explain what metadata sharing and/or other strategies you will use to facilitate widespread discovery and use of the digital content, resources, or assets created during your project (e.g., an API [Application Programming Interface], contributions to a digital platform, or other ways you might enable batch queries and retrieval of metadata).

As a part of our communications and outreach, we will work closely with ATALM and the other five tribal libraries to raise awareness about our project at a national level (e.g, during ATALM conferences, publications, etc.). Through this process, we will work to inform other tribal libraries and their communities about the availability of the broadband measurement system, as well as our three final project deliverables, which they will be welcome to use in their own libraries. We will also work to include information about all partners who were involved in our research project and the participatory process used to develop the research initiative.

D. Access and Use

D.1 Describe how you will make the digital content, resources, or assets available to the public. Include details such as the delivery strategy (e.g., openly available online, available to specified audiences) and underlying hardware/software platforms and infrastructure (e.g., specific digital repository software or leased services, accessibility via standard web browsers, requirements for special software tools in order to use the content).

As we describe in our proposal narrative, five participating tribal libraries from across Indian Country will work with the research team to co-design the following three project deliverables: (1) an update to ATALM's 2014 report "Digital Inclusion in Native Communities: The Role of Tribal Libraries," (2) a Digital Inclusion Lab "How-To Guide," which will provide substantive, co-authored instructional material that can be used throughout Indian Country, and (3) a final report with lessons learned and best practices from our participatory community informatics research project. After consulting with ATALM and the five participating tribal libraries, we will suggest that we use the Harvard Dataverse platform to make all of these deliverables, as well as the broadband measurement data produced through this research project, open access and freely available to the public.

The project team will also make sure that each of the tribal libraries and their communities retain ownership of the documentation produced by this research project. Any software, analysis code,

and other technical resources will be stored in a central repository on the Harvard Dataverse, where it will remain available after program completion, if agreed upon by ATALM and the five participating tribal libraries.

D.2 Provide the name(s) and URL(s) (Uniform Resource Locator) for any examples of previous digital content, resources, or assets your organization has created.

https://slis.simmons.edu/blogs/mlbn/

Part III. Projects Developing Software

A. General Information
A.1 Describe the software you intend to create, including a summary of the major functions it will perform and the intended primary audience(s) it will serve.

The software that will be further developed for this project will build on lessons learned from our previous IMLS grant, titled "Measuring Library Broadband Networks for the National Digital Platform," a grant (award #LG-71-18-0110-18). The software will build upon the three primary components described below. The requirements for each of these components will continue to be developed using participatory methods with our five participating tribal libraries for this research project. As such, the components and functions described below are generalized to some degree, knowing that additional needs or changes may be required once we have completed the initial work with participants from the five participating tribal libraries.

1. ***Client Test Runner -*** Software running on each network measurement device will run automated network measurement tests and sending the resulting data to the cloud service described in #2 below. This software will be installed on each measurement device, which will receive its configuration from the cloud service described below. This software will be used by the project team, but will also be of interest to IT staff or library staff with technical backgrounds.

2. ***Data Receiver, Visualizer, and Archiver Cloud Service -*** Cloud service software was developed to receive test data from each measurement device (client), archive it, and provide visualization of the data for analysis. This cloud service provides basic authentication and authorization functions, to provide program staff and designated library or IT staff from partner libraries the ability to login and explore visualizations of collected network measurement data. This software component runs on a server, virtual machine, or cloud hosting provider, and was developed with portability in mind, such that the component could be installed in a variety of environments.

3. ***Client Provisioning and Management Cloud Service -*** We will subscribe to a second cloud-based service called *Balena.io* to administer, provision, and update all of the measurement computers to be used on the project. This will allow easy setup of new devices, and to access and troubleshoot them remotely during the course of the first and second stages of this research pilot. *Balena.io is committed to open source release of their entire codebase*, and their commercial offerings help sustain this development path. Their paid service tiers provide a turnkey service which we will use on this project, but

we also expect that all components of their service will be open sourced, and available for technical implementers to replicate in the not distant future.

A.2 List other existing software that wholly or partially performs the same functions, and explain how the software you intend to create is different, and justify why those differences are significant and necessary.

While many network measurement projects have developed a similar system for single measurement tests, i.e. code runs tests from a computing device and sends data elsewhere, to our knowledge a single open source system that implements multiple network measurement tests and provides a central server for data storage and analysis has not been implemented. In cases where an existing open source software could be used to meet the requirements for any one system component, the team will leverage that software.

B. Technical Information

B.1 List the programming languages, platforms, software, or other applications you will use to create your software and explain why you chose them.

The research team will utilize a broadband measurement system created by M-Lab through our previous IMLS grant, titled "Measuring Library Broadband Networks for the National Digital Platform," (award #LG-71-18-0110-18). M-Lab is well-versed in programming languages such as Python, JavaScript, and HTML. Our project team will continue to have access to the team at M-Lab who has in-depth experience with many open source software which will be used for some components of the measurement system. In general, we will select programming languages based on input from M-Lab, our advisory council, and our team's expertise with the language. For third party open source or proprietary software we will ensure that the product has a strong user base and support community, which we will determine working closely with M-Lab and our project partners.

B.2 Describe how the software you intend to create will extend or interoperate with relevant existing software.

The measurement device software that we intend to further develop through this research, in consultation with M-Lab and our project partners, will use multiple network measurement software products and will send data to a central service. As such, the research team will work with M-Lab to continue to design a client software that will enable the interoperability of these tests to be scheduled and run from a single computer, instead of installing and running each measurement test separately.

Similarly, most existing open source network measurement software tests submit their results to a central storage location provided by the developers of that service. In the case of M-Lab tests, the resulting data from multiple tests are stored centrally and made available by M-Lab, but in a general format that is specific to the M-Lab community alone. Thus the *Data Receiver,*

Visualizer, and Archiver Cloud Service will provide a central storage and analysis service for specific communities to use, rather than the general use case described above for M-Lab, or similar services provided by individual measurement test developers.

B.3 Describe any underlying additional software or system dependencies necessary to run the software you intend to create.

All software to be further developed for the measurement devices and servers will require the Linux operating system.

B.4 Describe the processes you will use for development, documentation, and for maintaining and updating documentation for users of the software.

All M-Lab related code that will be used and further developed through this research project will continue to follow a rigorous quality control protocol during development. A new project typically begins as an idea, which is discussed by the team. If a decision is made to move forward, a design document is produced and discussed. Once a project is approved for development, all coding is done in a developer's fork or in a feature branch, and submitted to at least one other team member for code review. Reviewers must provide approval before any code is merged into a master or production branch. M-Lab also builds quality control into the development process itself by using integration tests and commit hooks, which test the code for stylistic compliance. M-Lab also leverages continuous integration testing from Travis-ci.com on each commit and/or pull request. Lastly, software releases are tested on a testbed of hardware devices prior to any production roll out. M-Lab maintains a test network of servers and client hardware, as well as an inventory of measurement devices that were used in this research, so any part of the measurement system can be tested independently or concurrently, in a separate, offline environment.

B.5 Provide the name(s) and URL(s) for examples of any previous software your organization has created.

Measuring Broadband in Alexandria City Public Schools
- Project page:
    - https://www.newamerica.org/in-depth/measuring-broadband-alexandrias-schools/
- Data analysis code:
    - https://github.com/opentechinstitute/bb-schools-analysis
- Prototype measurement system code:
    - https://github.com/opentechinstitute/mlab-governor-client

Piecewise - M-Lab based community engagement software
- Documentation and code:
    - https://github.com/opentechinstitute/piecewise
- Live examples in use by partners:
    - Seattle, WA - http://www.seattle.gov/broadband-speed-test

- ○ Stevens County, WA - https://stevenscountybroadband.net/
- ○ Clearwater County, ID - https://ed-broadband.clearwatercounty.org/

Measurement Kit Rpi - Automatically run M-Lab tests from a small computer
- ● Documentation and code: https://github.com/opentechinstitute/mk-rpi
- ● Blog post - Building Raspberry Pi M Lab Autotester: https://opentechinstitute.github.io/2017/10/building-raspberry-pi-m-lab-autotester/
- ● Blog post - Deploying and Managing a Fleet of Measurement Kit Devices: https://opentechinstitute.github.io/2017/10/deploying-and-managing-a-fleet-of-measurement-kit-devices/

C. Access and Use

C.1 We expect applicants seeking federal funds for software to develop and release these products under open-source licenses to maximize access and promote reuse. What ownership rights will your organization assert over the software you intend to create, and what conditions will you impose on its access and use? Identify and explain the license under which you will release source code for the software you develop (e.g., BSD, GNU, or MIT software licenses). Explain and justify any prohibitive terms or conditions of use or access and detail how you will notify potential users about relevant terms and conditions.

Software produced under this program will be assigned an MIT license, as is consistent with other software produced by Measurement Lab. The MIT licence is a permissive license that places only limited restriction on reuse. Data produced using M-Lab tools integrated into the software will be licensed using the Creative Commons Zero license, consistent with M-Lab's licensing practice for data produced by tests running on the M-Lab platform in the public domain. Content and other digital products produced by the program will be licensed using the Creative Commons Attribution-Noncommercial-Share-Alike 4.0 license which allows reuse with attribution for noncommercial use. Copyrights for software produced will be held by Measurement Lab, a fiscally sponsored program of Code for Science and Society.

C.2 Describe how you will make the software and source code available to the public and/or its intended users.

All software and source code will be made available publicly in a Github repository at M-Lab.

C.3 Identify where you will deposit the source code for the software you intend to develop: Name of publicly accessible source code repository:

- ● https://github.com/m-lab/murakami/
- ● https://github.com/m-lab/murakami-viz/

Part IV: Projects Creating Datasets

A.1 Identify the type of data you plan to collect or generate, and the purpose or intended use to which you expect it to be put. Describe the method(s) you will use and the approximate dates or intervals at which you will collect or generate it.

Quantitative data collected by measurement tests is described in the supporting document: *Available Broadband Measurement Tests.* Software running on small computers will initiate all measurement tests. The period of collection will be determined during the program itself, in collaboration with partner libraries. The data generated by each test will be sent to a cloud service developed for this program, where it will be stored, visualized, and made accessible. Additionally, tests will send their measurements to the project or platform from which the test originated. For example, all M-Lab tests will also send their data to the public M-Lab dataset, and Ookla tests (if implemented) will also send their data to Ookla servers.

A.2 Does the proposed data collection or research activity require approval by any internal review panel or institutional review board (IRB)? If so, has the proposed research activity been approved? If not, what is your plan for securing approval?

The collection of quantitative data does not require institutional review board approval, as these tests will not involve human subjects.

A.3 Will you collect any personally identifiable information (PII), confidential information (e.g., trade secrets), or proprietary information? If so, detail the specific steps you will take to protect such information while you prepare the data files for public release (e.g., data anonymization, data suppression PII, or synthetic data).

In some jurisdictions, the IP address assigned to a customer premise device (CPE) is considered personally identifiable information (PII). Internet measurement tests used by the software produced do collect this IP address. M-Lab provides provision in its Privacy Policy for users who wish to have their results anonymized or removed from its public dataset. The software does allow for results including IP address to be collected by the entity using the software, and to save those results on private infrastructure. Therefore the entity using this software will be considered the holder of that data, and would need to address any potential PII issues in their own policies. No other data except IP address is collected that would require permission or rights, or which would raise cultural sensitivities. Any concerns regarding privacy will be documented.

A.4 If you will collect additional documentation, such as consent agreements, along with the data, describe plans for preserving the documentation and ensuring that its relationship to the collected data is maintained.

N/A

A.5 What methods will you use to collect or generate the data? Provide details about any technical requirements or dependencies that would be necessary for understanding, retrieving, displaying, or processing the dataset(s).

Broadband measurement tests will run from small computers placed in each library's networks. Each device will need to have access to the Internet. Some measurement tests may require specific firewall ports to be available for use in order to run. Program staff will provide documentation in these cases, and work with the tribal library consultant and tribal library staff / IT support to communicate the required configurations. Requirements for understanding and displaying the data generated by broadband measurement tests will be gathered in the initial phases of the project, and iterated to ensure they meet end user expectations. Data will be submitted to a cloud service developed for the explicit purpose of understanding, retrieving, displaying and processing the dataset, which will use standard open source tools and code wherever possible. Once requirements are gathered for this system, dependencies will be documented, as will the setup and management of the entire system.

A.6 What documentation (e.g., data documentation, codebooks) will you capture or create along with the dataset(s)? Where will the documentation be stored and in what format(s)? How will you permanently associate and manage the documentation with the dataset(s) it describes?

All code used to generate quantitative data and the analysis of it will be documented and stored in the same Github repository. Documentation will be created in Markdown format, and will be viewable alongside code in the repository.

A.7 What is your plan for archiving, managing, and disseminating data after the completion of the award-funded project?

Data produced by M-Lab measurement tests from devices placed in tribal libraries will be submitted to M-Lab, but also will be maintained as a separate dataset in the data collection and visualization system to be produced by the project. We will publish an archive of the project data as well, in consultation with ATALM and each of the five tribal libraries, in the Github repository alongside other code assets, and on the project website.

A.8 Identify where you will deposit the dataset(s):

Name of repository: Harvard Dataverse
URL: To be determined

A.9 When and how frequently will you review this data management plan? How will the implementation be monitored?

Once a year, when we review our IRB status at Simmons University and in consultation with ATALM and the five tribal libraries participating in this project.