Observing social-ecological design of permafrost landscapes: Grounding urban planning in Utqiaġvik, Alaska

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ABSTRACT

How can Utqiaġvik develop new strategies of urban design on changing permafrost? Ongoing ethnographic analysis of the University of Virginia's project, "Understanding the Changing Natural-Built Landscape: An Integrated Urban Sensor Network in Utqiaġvik, AK," provides insight into how "design process" can help develop adaptive urban permafrost landscapes. Anthropological analysis of designers provides insight into how interdisciplinary practices create social-ecological change, and this paper builds on previous ethnographic work of the socio-political aspects of infrastructure and urban space. This UVA project uses design process, a collaborative approach common in architecture and other fields, in partnership with utilities and public services in Utqiaġvik, to co-develop relationships between urban planning, micrometeorological and ecological data, and permafrost. I analyze preliminary ethnographic observations of the cooperative dynamics of this project, including cross-disciplinary data collection structure, a "design studio" course's production of data-informed design proposals, developing discussions of water, snow, and thermal management, and input from community partners. Local residents have clear relationships of savvy renegotiation of the built environment, and snow removal maintenance emerged as a potential crux of designed change connecting hydrological data, ground temperatures, infrastructural impacts, and public services. Visualization of potential design solutions provides an accessible projection of possibilities for change that allow reconceptualization of relationships between city and permafrost. I argue that this project's work, as an iterative design process, integrates data, community experiences, and creative ideation. This integration allows Arctic urban residents and planners to redesign interactions with the land grounded in conceptions of permafrost as a social-ecological infrastructure and malleable architecture, potentially promoting senses of lived engagement with the changing land.

1 INTRODUCTION

1.1 Change toward adaptable landscapes

Utqiaġvik is growing. A friend of a friend, a retired nurse, walked me around her house pointing out changes inside and out: the new addition built in the 90s, that one spot in the floor that never seems to be level, and all her good friends and neighbors living up and down the street. None of these neighbors' homes were built when she moved to this house in the 80s, decades before the new hospital facilities were built two blocks away. She remembered the open tundra that used to surround her home: "Oh, it was beautiful, but you know, they [Utqiaġvik residents] need the space!".

Two days later, just a few blocks to the south, I hiked across tundra with my aquatic scientist colleagues toward their last years' pond sites. Looking out over the area, slated for future subdivision and development evidenced by new survey markers dotting the broad drained-lake basin, our bear guard talked of how he used to play out here as a kid—his uncle lived nearby—back when the old ice cellar near our sample ponds seemed miles and miles away to his short kid legs. A new road to the nearby gravel pit had sprung up since our study began: the aquatic scientists weren't sure until they reached their sites whether the road had disrupted them. We heard often from project partners at the utilities co-op how plans for a new college campus, new police station, would soon be needing new electrical substations to meet new demand. Utqiaġvik grows and expands, always on a dynamic permafrost substrate.

Utqiaġvik is the northernmost community in the U.S. Arctic, located on the Chukchi Sea. The town is built entirely on continuous, ice-rich permafrost, with maximum active layer depths of 35 to 50 cm (Klene et al. 2013). Residents of Utqiaġvik are aware of the infrastructural issues facing their city: frost-jacking, subsidence, standing water, snowdrifts, coastal erosion, and disrupted utilities are all problems encountered at varying degrees of severity every year. Providing strategies to plan sustainable futures for Utqiaġvik's built environment is the goal of the University of Virginia's (UVA) National Science Foundation (NSF) "Navigating the New Arctic" (NNA) project of which I am a part. I study the work of my colleagues at UVA and in Utqiaġvik to understand the social effects of their collaborations. In this preliminary analysis of this ongoing project, I provide emerging insights of how a group of researchers and community partners are using iterative "design process" (a collaborative approach common in design fields like architecture) to synchronize urban planning with permafrost dynamics.

An ethnographic analysis of a project aimed at improving design of Arctic cities must ask what does "doing design process" *do?* How can this interdisciplinary approach affect the relationships between designers, planners, residents, scientists, and the Arctic environment? Toward further understanding the social role of research in the Arctic built environment, this paper asks: What is the social effect of this project, if the project itself is not leveling buildings, repairing infrastructure, or building houses? The deliverables of the project include urban design suggestions, data to support best practices, and computer models of sample sites, but a further effect of the project is

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conceptual. The process of sketching new ideas and connecting different kinds of knowledge provides an opportunity to reconceptualize permafrost from a natural infrastructure to adaptable, negotiable social-ecological architectures which can be designed and coproduced, operationalizing relationships between the social and material aspects of the permafrost landscape. By looking at 1) the way that the project coalesces around water management as a central engagement, 2) how the project reflects local ideals of creative manipulation of the built environment, and 3) the projection of creatively-visualized ideas as products, my ethnography of this interdisciplinary collaboration describes how the design process creates conceptual space for urban design that is synchronized with the rhythms of the permafrost landscape.

1.2 Project Structure and Partners

The possibility of the design process changing social relationships to permafrost in Utqiaġvik begins in the structure of the project analyzed in this paper: the University of Virginia's National Science Foundation – funded Navigating the New Arctic five-year research grant, entitled "Understanding the Changing Natural-Built Landscape: An Integrated Urban Sensor Network in Utqiaġvik, AK" which began work in 2021. The project aims to improve understanding of the relationships between Utqiaġvik built environment—including buildings, utilities, and roads—and the surrounding air, ground, and water. By understanding how the town's infrastructures affect permafrost, the project team aims to propose changes to urban planning and design which can mitigate existing impacts on infrastructure, and increase the resilience of communities' future planning and design in the face of climate change. Though engineered solutions to problems of Arctic infrastructure already exist[1], and adaptations to climate impacts including permafrost thaw have been considered in the North Slope Borough (NSB) Comprehensive Plan (2019–2039) the project aims to ground these solutions in fine-scale definition of the interactions between built structures and permafrost stability, in recombination of existing practices, and in the social aspects of living, working, and knowing in this place.

The project aims for interdisciplinary structure and collaboration with local partners along three main branches of the project: sensor data, urban design, and social science. The PI's come from terrestrial ecology (Howie Epstein), aquatic science (Claire Griffin) architecture and geophysics (Matthew Jull), landscape architecture (Leena Cho), anthropology and data science (Luis Felipe Murillo), and science and technology studies (STS; Caitlin Wylie). The project contracts its project logistical support with TRIBN, Inc. (Lars Nelson) in Utqiaġvik, and works locally with Barrow Utilities and Electric Cooperative, Inc. (BUECI), Arctic Slope Native Association (ASNA), the Tagiuġmiullu Nunamiullu Housing Authority (TNHA), the NSB Planning Department, NSB Capital Improvement Program Management (CIPM) and NSB Public Works, and partners with the Cold Climate Housing Research Consortium (CCHRC) of the National Renewable Energy Lab (NREL) and the USACE Cold Regions Research and Engineering Laboratory (CRREL). Preliminary meetings with local partners both guided the delineation of research questions, as well as eventual site selections, and their participation continues to shape the interests and outcomes of the research.

The project has three ongoing strands of activity. The first is collection of micrometeorological, geophysical (LiDAR, ERT, and GPR) and hydrological data in the urban area of Utqiaġvik, and analysis of correlations in the time series data. The second is the translation of scientific data and related findings into a potential list of actionable design factors to improve the management of the built environment, including 3D spatial modelling and hosting two "design studio" field courses in Utqiaġvik. The third simultaneous project is that of ongoing ethnographic observation of cooperation both among the team and with community partners, seeking best practices for collaborative projects in the Arctic.

Over the first two years of the project, sensor installation has concentrated on the sites of the project's main community partners: the BUECI water and sewage treatment facility, the Samuel Simmonds Memorial Hospital (SSMH) run by ASNA, the "29-Unit" residential building managed by the TNHA, and a tundra control site on the Barrow Environmental Observatory (BEO) "Scientific Research District" managed by UIC Science, a subsidiary of the local Ukpeaġvik Iñupiat Corporation (UIC). Remotely monitored sensor stations monitor multiple variables at different aspects of each site[2]. Aquatic sampling and hydrologic analysis also concentrated on sets of urban-connected ponds intersecting with terrestrial sampling sites, additionally intersecting GPR and ERT sampling contracted through CRREL.

Figure 1. UVA aquatic scientists locating pond sampling sites, with Utqiaġvik neighborhoods in the distance.

[1] See CCHRC, CCREL

[2] Wind speed, wind direction, gust speed, air temperature, relative humidity, solar radiation, snow depth, ground temperature

1.3 Anthropology of infrastructural design

This paper analyzes the outcomes of a project which uses, in part, "design process" to find new solutions to permafrost problems. Design process, loosely defined, is an iterative, collaborative method used in many fields of architecture, engineering, etc. to address complex problems (Brown 2008). The UVA NNA project creates a design process through its multidisciplinary structure requiring digestion of multiple kinds of data, through multiple rounds of data collection, studio, proposition, and redirection.

Anthropological analysis of design process is a multifaceted subfield addressing multiple scales of "design" (Murphy 2016): there is anthropology of designed spaces, anthropology of designers, and anthropology through design which uses design process in its research methodology, sometimes in turn "for" design to improve design process. Some seek to bridge between anthropology and design to analyze development of new knowledge categories over the course of unfolding design process in a team including anthropologists (e.g., Gunn and Donovan 2012).

Interest in architecture and infrastructure reflects classically anthropological interests in space and place in anthropological literature (Low 2009), as well as renewed interest in the social roles of materials and objects. Anthropologists have focused in on architecture as a form of material culture, such as indigenous architectures (Lee and Reinhardt 2003), or as an expression of ideology (Humphrey 2005; Stender 2017). Caroline Humphrey (1988) points out that architecture has been less examined by anthropologists than other forms of "studying up," perhaps because of its many overlaps, though anthropological analyses of planning processes work to outline the politics and social practices of urban form and function (Holston 1989; Rutheiser 2008; Sadana 2018).

1.4 Studying Arctic Infrastructure

My theoretical stance in this project joins in anthropological analyses of how infrastructures include both material and relational or symbolic processes to structure social landscapes (Larkin 2017; Star 1999). Other ethnographies of infrastructure (Anand 2015; Harvey and Knox 2015; Nielsen 2022) further trouble the false dichotomy between built and natural environments and bring the unseen structures of infrastructure to the fore (Carse "Keyword: Infrastructure" 29). As an example, in Alaska, Elizabeth Marino's (2015) *Fierce Climate, Sacred Ground* links colonial ideologies of home, city, and education to the insufficiency and instability of rural Alaskan Native villages, especially those now requiring relocation due to fast-eroding coasts and riverbanks, further exacerbated by climate change.

Growing interest in the impacts of infrastructure on permafrost, and of changing climates on infrastructure's permafrost setting, has included other anthropologists' analysis of arctic infrastructure. Schweitzer, Povoroznyuk, and Schiesser (2017) argue specifically for re-centering social and landscape analyses of the Arctic away from naturalized concepts of wilderness toward the important social roles of the built environment.

Architectural studies, such as Jull's overview of the "microrayon" (2016) and Sheppard and White's (2017) *Many Norths* show the cultural, historical, and material parameters of Arctic architecture. Steinberg (2019) points out how the Arctic's land, water, ice material dynamism resists typical binaries of architecture, politics, governance from temperate areas (in Cho and Jull 2019, pp. 52–55). These extreme material differences of the polar climate Cho and Jull describe as forcing designers—resident or otherwise—to "innovate cultural and material linkages" (p. 23). Design process becomes an opportunity to re-think relationships to material environments.

Cho and Jull compiled their 2019 *Mediating Environments* to communicate routes toward "new relationships to environments" (p. 24). In this book they describe that design

> "has the capacity to act as an intervening agency and to reify the link between the living and the environment that envelops it. Its capacity to bring about change, subtle or radical, can fundamentally restructure the relationships among things, and the modes by which our beliefs and ways of living are materialized." (p. 22)

Here I describe the practice of this restructuring through ethnographic analysis of the project's activities.

2 Methodology

This paper is based on ongoing participant observation of the UVA NNA project activities from June 2022 to August 2023, during installation and subsequent maintenance of micrometeorological sensor arrays and aquatic sampling sites in the Utqiaġvik urban zone and the BEO tundra control site. Though born and raised in Alaska, this was my first trip north of Anaktuvuk Pass and thus my first introduction to the community of Utqiaġvik. Besides these field visits, I also participated in biweekly project meetings, terrestrial sensor meetings, outreach committee meetings, geophysical data meetings, and fieldwork planning meetings with UVA team members over Zoom and telephone. The corpus of my data also included reading publications by team members and partners, and any intra-project email correspondences. I performed preliminary follow-up interviews with team members and project partners, with research ongoing.

My participation and observation in the project's associated "design studio" course in architecture and landscape architecture—taught by PI's Cho and Jull—was an important part of my understanding how design process and ideation fit into the goals and outputs of the NNA project. All architecture and landscape architecture students at UVA take "design studio" courses, intensive courses which include important professionalization and training toward their future careers. Cho has written of the important role of embodied experience for studio students (Cho 2022). I participated in the "pin-up" of the students' in-class research (visual and oral presentation of draft pages literally pinned to a wall), their project proposal "review" presentation, and then accompanied their visit to Utqiaġvik in February 2023. During the visit I observed and participated in their group debriefs and site visits, and their scheduled meetings with BUECI, TNHA, and NSB

representatives. Later in the semester I then participated in the “final review” of their final projects.

Working toward understanding the impacts of the project’s structure required considerable “language acquisition” of the vocabulary of permafrost ecology, architecture, design, and landscape architecture. I arrived in Utqiaġvik with the design studio students still asking endless questions to try to understand what a “design studio” really was, unveiling my lack of comprehension of terms of “design” and “design tools” and “sketch” among others. Sharing terms was important for understanding the social frictions of design: NSB employees later teased Jull for his discipline’s use of “charette” to describe seawall plans, “CCREL uses those words too” they roared with laughter. Besides vocabulary, my ethnography also serves as a kind of translation of the visual work of the design process into my own analysis.

The interdisciplinary, intercultural, multi-sited context of my ethnography provided friction between backgrounds which increases the visibility of changes in relationships to material and immaterial landscapes. Explaining the role of an ethnographer to my colleagues promoted a further iteration of describing how relationships are made and shifted. Just before departing with the studio class, I was reminded by Jull that he was “still totally in the dark” and needing clarification of my intentions in observing the trip. Gunn and Donovan (2012, p. 7) describe that ethnography of design practice can “reveal differences and crossovers in order to allow people to have a more sophisticated way of knowing what they do, and to make many different understandings present,”. One such understanding which I describe in this paper, is that of interpersonal engagements building toward common reconceptualizations of landscape.

3 Results

The themes I identify here as emergent across the project’s first few field seasons, mark an ongoing articulation of multiple forms of data—from sensors to conversations—toward more malleable relationships between permafrost and built environment. The processes I follow in this paper that trace this shift are the project’s refocusing on maintenance, and modes of proposing creative but practical ideas and visualizations, both converging with local definitions of re-design.

3.1 Local forms of design

Interactions between permafrost, urban planning, public services, and community members are shaped by local concepts of change and utility in the material environment: local processes of design. The social analysis of the project’s activities through the commentaries of local partners and community members were often made in the down time of the project, just after a presentation or discussion, or while problem-solving the many technical issues of the sensor arrays.

A hardware store employee commented that “people up here, we are good at working with what we have”. He patiently fielded our questions of how best to protect a deep-cycle battery we were rigging to get our solar-powered data-loggers through to spring, describing a potential workaround of bagging the battery in plastic and using spray-foam inside a plastic tote. A day later a member of the NSB planning department riffed on description of the “interdisciplinary” strengths of our NNA project, commenting that even beyond interdisciplinarity and survival, “elders are the original MacGyvers!”

Figure 2. UVA Design Studio students discuss culvert drainage and snow removal at North Slope Borough Public Works garage.

Similarly, standing in the unfinished hallway of an apartment renovation project as Design Studio students explored the airflow and lighting of the space, a TNHA manager chatted about the goals of our NNA project, which includes a set of “design tools”, ending the conversation by relating how people across agencies were wary of “overengineered” solutions: they weren’t going to “go out on a limb” for something that hadn’t been tried and true somewhere else. The comment was a bit of a warning against anything beyond local capacity.

Such comments show not only how rural Alaskans are open to rearranging their relationships to material objects, but also the importance of humble simplicity when approaching future-oriented solutions for local problems.

3.2 Maintenance

Snow removal strategies and other forms of water management maintenance emerged as an important intersection of terrestrial, aquatic, and community

datapoints. Standing water is a known amplifier of active layer thaw, and a highly visible problem in Utqiaġvik neighborhoods and along roadways. As the aquatic scientists focused their interests on both original plans for tracking water movement through tundra ponds, they also shaped transects to pick up impacts associated with increased snow-depths near snow fences. Terrestrial sensors' metadata also reflected potential early signals of correlations between relative distances to nearby lagoons and annual snowdrifts—both naturally occurring due to building configuration and man-made due to snow removal piling.

Though "maintenance" does not appear in any of the UVA NNA project's proposal text, it is an increasingly recognized aspect of process-oriented landscape architecture (Raxworthy 2018), the category began to take on importance as a key word over the course of the design studio class. When students arrived at TNHA 29-unit, they were confronted with a massive snowdrift in the lee of the building, as well as a big pile by the lagoon, where Public Works amasses snow from surrounding roads.

At a meeting with NSB representatives, from NSB Planning, Public Works, and Capital Projects, Jull and Cho presented a brief overview of the NNA project's goals, and the studio students introduced themselves and spoke about some of the research they did to prepare to visit Utqiaġvik. The discussion ranged from the seawall, to construction trends, to Point Lay's infrastructure disruptions, and the students asked questions: "why is the hospital built in a bowl?" and "what do you do with the snow". Public Works director Scott Danner described the snow removal, and Jull saw the opportunity to extend the students' experience in this direction: "Hey can we come visit?" "Sure" was the hospitable response, "What do you want to see?" The next day, the class filled the spaces between snow removal machines in the NSB shop. One group's final project, titled "Water in the Desert: Experimental maintenance as a socio-ecological practice in the Arctic Tundra" catalogued snow management strategies that might both increase outdoor social space and minimize snow-depth and melt impacts on ground temperatures.

Months later at the studio's final review presentation, when Cho and Jull were introducing the NNA project to invited architecture reviewers, visitors including Nelson, and partners in Utqiaġvik who were able to join via Zoom, Cho interjected "and maintenance regimes" to the list that Jull was naming of the goals of the project: maintenance had moved toward the center of the project.

3.3 Social role of ideas and visualization

At the final studio "review," the presentation of the students' final projects, comments from reviewers, including Lars Nelson, circulated around practicality and budgeting of these projects. This tension underlines both the importance of practicality, as well as the role of creative speculation in the design studio. Several questioned the costs associated with the students' ideas, and Nelson noted that the presentations were high quality but "What's missing is the money."

Figure 3. Winter snow dumpsite at the edge of Utqiaġvik with standing water beside road.

Besides design propositions for new structures—a boardwalk, a greenhouse—the students' designs reflected programmatic elements, such as coordinating snow management, and visualized relationships between the project's scientific data and community concerns such as subsidence or flooding. Another project visualized a strategy of aligning new subdivisions along ice wedges rather than a standard grid. Nelson noted that streets are already oriented to advantage scouring, and that snow compaction is a known best practice already: the work of the studio lay in the visualization and conceptualization of future urban groundings.

While in Utqiaġvik, Nelson had emphasized the power of the visualizations, how "people want to see" new ideas. Remembering the results of past studios, he commented that "if you showed a drawing of an indoor playground to an elder they'd be like wow, I've been thinking about that my whole life." Before their departure to Utqiaġvik, in discussion about presenting their research to the project's community partners, Cho had cautioned the students about the precarity of balancing others' expectations with the aesthetics of their visual products. Having drawings look "finished" has weight, implies certainty which promotes a more "top-down" design process rather than remaining open to the input of the community.

Visual aids further develop relationships to permafrost soil dynamics that will aid in future planning, promoting conceptual synchronization with permafrost whether along ice wedge lines or meltwater timing. In the example of the studio project centered on the SSMH hospital, Jull noted how the students' project created dozens of drawings, analysis, and considerations which could help further conversations or help the facilities manager create future plans.

4 Discussion and Conclusion

Ethnographic attention to interactions of researchers, partners, and residents with the UVA NNA project's design process helps understand how the structure of

interdisciplinary inquiry can synchronize social, municipal, and ecological rhythms to produce visualized ideas that enact new, cooperative relationships to Arctic environments. Through flexibility, humility, visual communication, and digestion of both qualitative and quantitative data, the design process creates opportunities to pursue more interactive conceptual relationships between infrastructural development and permafrost soils.

Permafrost is an integral foundation of many Arctic cities, and by revealing—and changing—relationships to the material ground, permafrost can be considered a social-ecological infrastructure in the expanded anthropological definition. As Larkin (2013, p. 329) writes, "What distinguishes infrastructures from technologies is that they are objects that create the grounds on which other objects operate, and when they do so they operate as systems,". The design propositions grounded by scientific data collection and visualized into a haptic reality further produce permafrost as a manipulable architecture. "We haven't really considered this other field, of 'landscape architecture'" stated Lars Nelson in his NSB Assembly Member role during a workshop with the Assembly following an interdisciplinary "Permafrost & Infrastructure Symposium" in early August, 2023[3]. He described how "We need to terraform our community" so that building homes is still possible in the future.

Conceptualizing urban planning and design as seeking to synchronize with permafrost—as planning *with* permafrost rather than against—may have potential to increase the resilience of future development of the built environment in the Arctic. Though changes due to climate change increase the difficulties of building and developing infrastructure on permafrost, by grounding designs in deep understanding of social entanglement with permafrost dynamics, residents may feel fewer negative perceptions of impacts of permafrost thaw (Ramage et al. 2022), or less solastalgia, emotional distress due to environmental change (Albrecht 2010). By reflecting a more-than-human definition of fellow life in the landscape (Povinelli 2016), a more holistic metaphysical landscape can be affirmed along local cultural values of co-constitution of human and nonhuman (Tallbear 2011), such as Iñupiat Iḷitqusiat values of respect for nature and cooperation (Itchuaqiyaq et al. 2021). Perhaps synchronizing the creative use of urban space—from maintenance to building to planning—in synchrony with permafrost dynamics will promote a closer sense of lived engagement with the changing land, rather than only reactionary measures against permafrost degradation.

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[3] https://permafrostcoasts.org/activities/symposium

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