Stone is a reductive medium. When broken by heat, percussion, or pressure, the parent rock is inexorably altered, and visible and durable reminders of that activity are typically left behind in the form of flakes, cores, discarded implements, and other fragments. By this means, lithic residues come to mark places with histories of human visitation, association, activity, and memory that implore us to read the landscape as humanly inhabited and experienced in the past. Because the stone suited to this intentional shaping of tools and objects of trade or display derives from sources that are sometimes distinctive, unevenly distributed, and of varying quality, it provides us with a record of material transport and selection that is vital to connecting places, choices, and material residues to past human movements and people’s technological and social concerns. We also cannot downplay the important functional role that stone artifacts played in enabling people to make a living from the landscape—and hence the constraints on design, efficiency, and organization of production, use, and maintenance that lend lithic assemblages much of their character. These same artifacts also likely held meanings to past artisans beyond their mundane history or potentiality for use as tools, and the ethnography of Aboriginal Australia, for instance, provides many illustrations of the social, mythical, and genealogical meanings that inhere in particular stone outcrops, distinctive colors, and various artifact forms (Cane 1992; Gould 1968; Gould and Saggers 1985; Harrison 2002; Jones and White 1988; Paton 1994; Taçon 1991; Thomson 1949). Patterns of association between distinctive and nondistinctive lithic objects with significant or unique features of the natural or built environment can also point to the existence of symbolic or ritual connections to places in past societies.

Although stone artifacts theoretically stand to inform us about many dimensions of human experience, purpose, and creativity, it is a truism that extracting such information from lithic assemblages can be difficult. Yet this task is not impossible, and given the vast quantity of lithics in the archaeological record, their survival where other cultural traces have long since vanished, and their potential contribution in answering many questions about past societies’ engagement with landscapes, we must seek and assimilate such information into our narratives about the past. However, as with any kind of archaeological evidence, it is easier to glean information and build stronger narratives of past lifeways when multiple lines of evidence are available. Nevertheless, the purpose of this chapter is to identify and illustrate ways that stone artifacts can be used (on their own) to investigate the past cultural geographies of landscapes.
Four kinds of lithic evidence can be considered particularly useful in reconstructing past human engagement with the landscape: transportation, accumulation, association, and alteration. These evidential strands provide a basis on which to connect people to places and people to places at regional scales, and thereby reconstruct networks of social, technological, and economic relations across space and time. First, I review these concepts and particular methods that elucidate them as facets of human engagement with landscapes. These four lines of evidence are then illustrated in a case study from northern Australia in which multiple strands of lithic analyses are used to build an interpretation of past human engagement with the landscape that integrates ecological, economic, and social dimensions of human existence.

Using Lithics to Explore Past Cultural Landscapes

Transportation

Humans, and especially hunter-gatherers and early farmers, are rarely completely sedentary and must move and interact socially and economically over areas of varying size to obtain the materials needed to survive and to attain various goals. For most of human evolution, flakeable stone was one such resource that was often critical to survival, and people often journeyed far, or participated in exchange networks, to obtain it. Lithic assemblages can therefore be highly informative about the range of places visited in the landscape—particularly when lithic sources are distinctive—or the nature and direction of the social relations that enabled transfer of raw materials over distances.

Since one of the primary modes of human engagement with landscape is through individual or group mobility, stone artifact transport is a key line of enquiry in reconstructing the range, frequency, and predictability of residential moves in past societies (Blades 1999; Byrne 1980; Kelly 1992; Parry and Kelly 1987; Shott 1986; but see Brantingham 2003). Determining the exact pathways humans traveled, or even whether artifacts were transported by individuals or traded and exchanged between groups, is, however, a difficult task (Close 2000; Kelly 1988, 1992).

A number of methods are commonly used to build broad understandings of raw material transportation between stone sources and places of discard. These include a battery of chemical (XRF, NAA, INAA, ICPMS, PIXE/PIGME) and visual (color and texture, thin sectioning, microfossil identification) identification techniques for sourcing stone to its original outcrop (Clarkson and Lamb 2005; Shackley 1998; see Summerhayes, this volume, for descriptions of these chemical techniques; see also Weisler, this volume), refitting artifacts at sites across the landscape (Close 2000), and studying transformations in artifact form that result from curation of artifacts and rationing of raw materials as they are moved away from stone sources (see transformation below).

The existence of a limited range of known and spatially separate and discrete raw material sources can greatly aid the identification of patterns of movement and even social differentiation. McNiven (1999), for instance, interpreted the gradual drop out of raw materials from known sources resulting in use of more and more local outcrops to support a model of group fissioning among coastal Aborigines under increasing population pressure in eastern Australia. Group fissioning gave rise over a period of several thousand years to small, well-defined group territories, linguistic differences, and formalized exchange networks that crossed rigid social boundaries. Another example of the value of tracing the transport of distinctive raw materials includes the reconstruction of enormous group territories among early north American societies and the contrast this enables us to draw between the way they used and experienced landscapes compared to later native American societies (Jones et al. 2003; Kelly and Todd 1988). The gradual accumulation of extensive knowledge about the sources of raw materials used to make flaked and polished Neolithic axes in Britain has also been used to reconstruct patterns of trade and exchange over vast areas, including potential centers of redistribution that point to the emergence of new social arrangements (Edmonds 1990).

Higher-level arguments are often formed about the nature of mobility and anticipatory use of landscapes from spatial patterning in lithic assemblages. For instance, many researchers have explored the various ways that patterns of raw material procurement, transportation, stockpiling, and husbanding can provide information about the frequency and nature of group mobility (Bleed 1986; Kuhn 1995; Nelson 1991; Shott 1986). Kuhn (1995) applies the term provisioning to the system of ensuring that cores or finished tools are available where and when they are needed.

Synthesizing many ethnographic observations of hunter-gatherer technology, researchers have found that people moving frequently through landscapes with little certainty about the places to be visited or opportunities for foraging and raw material replace-
multifunctional, long use-life tools that can be easily maintained using the transported toolkits to hand. Kuhn (1995) calls this strategy provisioning of individuals. Such toolkits often tend to be made from high-quality stone in order to increase the performance and use-life of tools that may have to remain functional for long periods (Goodyear 1989). In contrast, people moving periodically and predictably between locations tend to provision those places with raw materials rather than transport small toolkits. This enables the stockpiling of raw materials in anticipation of future needs as well as greater flexibility in tool production that allows tools to be specifically designed to suit current tasks and discarded in favor of new tools when they cease to be as efficient. Kuhn (1995) calls this strategy provisioning of places. Admixtures of both systems can coexist in the landscape, allowing different place usehistories to be determined. Hence, predictably occupied places that are used to stage long-distance logistical foraging trips might see the anticipatory production of mobile toolkits amid more expedient technological activities, and places that see infrequent or unpredictable use might at times be stockpiled with raw materials and spare tools cached to guard against future shortfall (Binford 1979). Although the principles on which these interpretations of the strategic organization of technology are derived primarily from hunter-gatherer societies, they have proved equally relevant in some cases to the way stone was used by early farmers (Bamforth and Woodman 2004; Edmonds 1990).

Identifying the archaeological correlates of these various strategies of artifact transport and supply can therefore help detect the different kinds of place use histories and the ways people likely regarded locations as intimate/domestic or less familiar/specialized use places. Thus, mobility might also play a key role in the way landscapes were experienced and visualized (Edmonds 1990, 1999; Thomas 2001; Whittle 1997).

**Accumulation**

The frequency with which people fracture stone at the same place in the landscape will result in varying sized accumulations of lithic debris remaining at those locations. The more stone is knapped, the more the archaeological record will be enlarged, and the more those events are spatially constrained, the denser those accumulations will be. The record of past visitations and the kinds of activities represented are routinely used by archaeologists to infer the intensity with which locations were occupied in some cases. Typically, this measure of occupation intensity is expressed as numbers, weight, or volume of stone artifacts per square or cubic meter. Of course, accurate interpretation of what caused such accumulations can be complicated, and the nature of flaking, the duration of occupations, and the number of people involved can all affect the record in similar ways (Hiscock 1981). Discriminating between these alternatives is difficult without detailed analyses and multiple lines of evidence. Nevertheless, we can say that varying accumulations of lithic debris point to the degree to which locations served as a locus for human activity, whether that equates to intensity of occupation or activity or both.

When varying accumulations of artifacts are viewed at landscape scales, they can inform us about the choices of individuals and groups about how much time to spend at a place, what and how much material to bring, and how much of it to discard there. In quantifying the amount of lithic debris found at sites, we must also be mindful that stone shatters to varying degrees according to raw material type and different manufacturing (for instance, bipolar vs. pressure) and taphonomic processes (for example, heating, freezing, trampling, snapping, plough damage, erosion, and slopewash), and we must therefore factor in as much as possible the effects of these processes in our calculations of occupation intensity. Hiscock (2002) and Shott (2000) have both devised means of calculating how much actual flaking was performed to arrive at more accurate descriptions of the intensity of occupation or of activities conducted at sites.

Lithic accumulations probably also played an important symbolic role in marking to passing or returning people that a place has a history. In some cases, lithic scatters may evoke mythological or creation stories about a place that might relate to the tool types or raw materials present, conjure the memory of close kin who stayed at the site, or, in cases where access to places is not tightly controlled, even prompt enquiry about who else has visited such places. Alternatively, lithic scatters may simply serve as reminders of past events or activities conducted at sites that could emphasize continuities in site use over time (Edmonds 1999). The scale and content of lithic accumulations might also signify the desirability of a location for habitation or serve a mnemonic purpose in reminding people of the raw materials that can be obtained locally or the social relationships that led to the accumulation of exotic or rare raw materials/objects visible on the surface. When episodes of
in ever-increasing accumulations of lithic material, we might expect these locations to become “increasingly symbolically charged, patterned, and contextualized,” to use Paul Taçon’s (1999: 41) words. Visible concentrations of lithic material can also serve as source zones for raw material acquisition and often show signs of scavenging and reuse that might suggest continuous re-visitatation, long periods of residence, or even dedicated visits to procure stone (Camilli and Ebert 1992).

In some cases, it is the subtraction of lithic material rather than accumulation that can lead to significant changes in the appearance and the experience of landscapes (Edmonds 1999; Field 1997). The extensive flint mines of Neolithic Britain are a classic example of the large-scale transformation of the landscape which in some cases appears to have resulted in the acquisition of symbolic significance, leading to frequent construction of high status barrows at mine sites (Field 1997).

Approaches that concentrate on the interpretation of artifact distributions, accumulations, and assemblage composition are ideal for the study of cultural landscapes; as a result, open stone artifact scatters commonly contribute the bulk of the data to landscape scale analyses (Torrence 2002). This can, however, give rise to significant interpretative and contextual problems, the most common of these being varying degrees of surface visibility leading to sampling bias and poor chronological resolution, particularly where temporal markers and datable materials are not present in exposed assemblages and where sites represent palimpsests and time-averaging of assemblages over long periods. These can prove problematic if the palaeoenvironmental and cultural contexts of different occupation episodes are significantly different, leading to quite different assemblage characteristics (Dooley 2004; Zvelebil, Green, and Macklin 1992).

**Association**

Archaeologists routinely look to patterns of association among lithic assemblages, distinctive artifacts, and physical and cultural features as a means of illuminating past human economic, social, and symbolic engagement with landscapes. Humans often center their activities on visually impressive and unique places (Bradley 2000; Taçon 1999), places of practical utility, as well as features of the built environment. Such features often reveal distinctive patterns of association with lithic assemblages, depending on the nature of the activities and meanings assigned to those places. The nature of lithic items around such features are therefore likely to be informative of the nature and importance of those places. Such “place use” histories tell us something about the nature of social engagement within defined locales that may differ from the broader socioeconomic use of landscapes, which I choose to call “land-use” in this chapter.

Burials, domestic structures, visually impressive edifices, monuments requiring huge investment of human labor to build or maintain, distinctive landscape features (such as caves, mountains, and unusual rock formations), astrological devices, and places offering sanctuary are all places where we would commonly expect to find lithic accumulations resulting from activities, performances, or acts of deliberate destruction that might point to ritual, symbolic, and other important social roles for these places. Examples include the repeated association between polished axes and causewayed enclosures in Neolithic Britain (Edmonds 1990), ceremonial knives and elite burials in Mesoamerica, cylindroconical stones and stone arrangements in Australia (Cundy 1985), and Gerzian ripple flaked knives and burials in pre-Dynastic Egypt (Savage 2001).

At a more mundane level, even evidence for the ceremonial knapping of stone in association with the opening and filling of funerary pits (Edmonds 1999), or the presence of simple flakes or distinctive raw materials in grave goods (Haglund 1976), or just lithic accumulations in association with distinctive natural features might point to particular significance for those contexts in the landscape.

Association is therefore a means of linking accumulations or unique objects to unusual contexts in the landscape, offering the potential to explore behavioral disjunctions that are suggestive of aberrations from more typical behavior or the emergence of new belief systems that might not necessarily be apparent from other aspects of material culture.

**Alteration**

Stone-working is a reductive process that alters parent stone through the successive and irreversible removal of material. How much a piece of stone has been altered can therefore tell us something about the amount of time and energy invested in the production of an artifact, the level of departure from the original form, the amount of material likely to have been created as a byproduct of the alteration process, and the position in the sequence at which changes in manufacturing strategies took place and their likely effects on artifact morphology. At landscape scales, archaeologists are often...
have been altered (typically in relation to distance from source or proximity to important landscape features) in order to understand systems of time budgeting, mobility, and land-use. This perspective allows investigation of the complex life histories of artifacts from procurement to discard so that the distribution of types and sequence of technological activities and the movement of artifacts in the landscape can be determined. This is because degree and nature of alteration (that is, the differential distribution of sequential steps and stages of manufacture and reduction in space and time) will often reflect aspects of planning, land-use, ecology, ideology, and settlement and subsistence patterns affecting people’s daily lives (Kuhn 1995; Nelson 1991).

A large literature has recently emerged developing methods for determining the extent of artifact alteration through reduction. It has mostly focused on artifact alteration through retouching, but studies of other kinds of flaking and grinding also exist, and techniques range from measurement of flake and retouch features (Barton 1988; Blades 2003; Clarkson 2002; Clarkson and Lamb 2005; Close 1991; Eren et al. 2005; Kuhn 1990), estimation of original size or mass (Dibble et al. 2005; Dibble and Pelcin 1995; Shott 1994), and refitting of artifacts to understand changing forms and reduction techniques (Cziesla 1990).

Ecological and Social Dimensions of Land-Use in Wardaman Country, Northern Australia

As an example of the above-mentioned potentialities of lithic analyses to landscape archaeology, the following example presents my own perspective on the changing nature of human engagement with landscape in Wardaman Country, northern Australia, over the last 10,000 years. Patterns of lithic transportation, accumulation, association, and alteration are explored to reconstruct economic, social, and symbolic aspects of place-use over this period (Clarkson 2006). Wardaman Country sits on the edge of the semi-arid zone in the Northern Territory and is a region divided between resource-rich, fertile alluvial plains and gorges (predominantly in the north of the region) that contain diverse high-ranked resources and abundant permanent water, and flat sand plains and black soil plains that are relatively poor in food resources with few and widely dispersed permanent waterholes (Clarkson 2004). These poorer, generally southerly areas typically contain abundant stone outcrops in the form of large habitable rockshelters manufacture, whereas more northerly, richer areas lack rock overhangs but contain numerous chert sources.

The location of critical resources such as water, shelter, raw materials, and dry locations above flood plains strongly constrains where activities took place in the landscape in Wardaman Country. As Figure 48.1 shows, the majority of lithic accumulations are focused around these features, such that almost no sites occur more than 2 km to any of these features (Figure 48.1).

Stone artifact accumulations also indicate that much more activity was focused in areas with abundant permanent waterholes, and rich plant and animal resources in northern parts of the study area. Furthermore, blanks for implement production (for example, pointed blades suited to the manufacture of points, tulas, side- and end-scrapers, and burins) and cores of nonlocal stone were often procured in the raw material-rich southern land systems and transported and stockpiled for use at spatially extensive sites in these northern richer areas of the study region. As previously noted, Kuhn calls this strategy of stockpiling regularly visited places place provisioning. These large sites also contain typically dense and highly diverse assemblages compared to those found in other parts of the study region, with abundant signs of implement manufacture, retooling, and recycling of implements.

Sites situated in these richer northerly land systems also frequently contained site furniture in the form of grindstones, hammerstones, and anvils imported from surrounding regions and kept at large camps where a range of tasks was predicted to occur on a regular basis. Sites located in poorer land systems tended to be either quarries at which cores were typically reduced to obtain pointed blade blanks and other flakes, or sites containing a high proportion of retouched implements (often extensively reduced and made of high-quality raw materials) typical of the kind of “individual provisioning” expected of highly mobile foraging trips targeting specific resources or searching for mobile or dispersed prey. The differences in overall land-use in Wardaman country can therefore be characterized as low-mobility, long-term occupation of numerous, large, predictably and regularly reoccupied base camps in the north, and high-mobility, short-term occupation of special-purpose camps while quickly moving through the landscape in search of resources or while procuring stone in the south. Northern land systems probably therefore represent landscapes that were familiar and “lived in” in comparison to those more transiently visited
Interestingly, it is also in these land systems of lower ranking that large rockshelters are abundant, often close to sources of raw material. These rockshelters are usually shady, secluded places with soft sandy floors suited to habitation and flat sandstone walls ideal for the creation of rock art (Figure 48.2). From the impressive accumulations of artifacts and rock art, it is clear that these places have been a significant locus of human occupation, tool-making, and artistic activities on a massive scale, with sometimes enormous and complex painted freezes of Dreaming beings (such as animals and the massive “Lightning Brothers” motifs) and extensive figurative and nonfigurative provide private spaces and are known ethnographically to have been used as places for the performance of restricted rituals and artistic activities.

Rockshelters are also the focus of unusual lithic associations with symbolic significance, such as exotic and mythologically charged Kimberley points, trade “Leilira” blades (Allen 1997; Thomson 1949), and cached items that may have been stored for times of shortfall and that are rarely or never found at the large open sites in northern parts of the study region (Figure 48.3). These items are usually hidden in narrow declivities, often close to human remains, and even include decorated boards of totemic and clan significance. However, the limited economic resources

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**Figure 48.1** Patterns of association between lithic accumulation and the nature of assemblages and important landscape features. X-axes are kilometers from closest permanent water, flakeable stone, shelter, and elevated terrain.

**Figure 48.2** Deep rockshelters in the central and southern parts of Wardaman Country.
at rockshelters throughout Wardaman Country (for example, Nimji, Garnawala 2, Gordolya, and Jagoliya) that the system of land-use and place-use changed dramatically over the last 15,000 years (Clarkson 2004, 2007). The frequency, predictability, and range of residential moves seems to have dramatically changed around 7,000 years ago, and occupational intensities greatly increased in rockshelters throughout the region (Figure 48.4). Stone was stockpiled at these shelters in the form of cores and large flakes; heavily retouched toolkits were rare, and raw materials were rarely imported from distant sources. This period was followed by a huge drop in occupational intensity between 5,000 and 2,000 years ago, at which time extreme individual provisioning seems to characterize the use of rockshelters. Exotic raw materials indicative of long-distance transport, heavily retouched implements with long complex use-lives including morphological transformations and recycling, and the use of small, standardized, portable, and presumably hafted toolkits dominate assemblages at these sites at this time. Between 2,000 and 1,000 years ago, occupational intensity peaks a second time, with reduced reliance on individual provisioning, greater use of local stone, and some discard of cores rather than just retouched implements. In the last 1,000 years, occupational intensity diminishes once more, and significant items identifying formal, long-distance social networks appear, such as Leilira trade blades and Kimberley points.

Given these changing levels of occupational intensity, and therefore probably also visitation frequency and familiarity as domestic places, we see that ochre deposition peaks at times of least occupational intensity (Figure 48.4). This suggests that places may have gained greater ritual significance and were more intensively decorated and maintained when visited less frequently, as certain activities could be more easily conducted in private and powerful ritual items stored without fear of loss or exposure to unsuitable eyes.

Major changes in rock art styles have also been documented in Wardaman Country that coincide with changes in land-use and occupational intensity as reconstructed from stone artifact assemblages and other lines of evidence (Figure 48.5). These include an early dominance of engraved rock art prior to 3,000 years ago (David, Chant, and Flood 1992; Mulvaney 1969; Watchman et al. 2000), followed by a change to the use of large figurative art panels (perhaps around 3,000 years ago) (Watchman et al. 2000) coincident with infrequent and highly mobile use of rockshelters, and finally their use to specific activities such as raw material procurement, ritual activity, and occasional habitation. In a landscape otherwise traversed quickly, and perhaps without the familiarity of more intensively occupied areas to the north, these outliers must have stood out as highly incongruous, visually distinctive, and perhaps daunting repositories of cultural capital and tradition that were to be either actively avoided or maintained and embraced, depending on one's social status in Wardaman society. They contained the direct linkages to the Dreaming—powerful objects and depictions, the remains of the ancestors and the material significations of past ritual and domestic activities that simultaneously attracted and repelled human engagement (Merlan 1989).

The use of these places was not static in time, and it is clear from numerous excavations their use to specific activities such as raw material procurement, ritual activity, and occasional habitation. In a landscape otherwise traversed quickly, and perhaps without the familiarity of more intensively occupied areas to the north, these outliers must have stood out as highly incongruous, visually distinctive, and perhaps daunting repositories of cultural capital and tradition that were to be either actively avoided or maintained and embraced, depending on one's social status in Wardaman society. They contained the direct linkages to the Dreaming—powerful objects and depictions, the remains of the ancestors and the material significations of past ritual and domestic activities that simultaneously attracted and repelled human engagement (Merlan 1989).

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other changes in rock art styles in the last 300 years (Attenbrow, David, and Flood 1995; David 2002), coincident with the appearance of Leilira trade blades and Kimberley points.

It is not surprising that major readjustments in land-use and engagement with landscape should be marked by equivalent changes in other spheres of human life, such as worldview, ritual, and art. David (2002) has recently argued, for instance, that ontology—or the system of meaning and preunderstanding with which people interpret the world and their own place in it—is fundamentally shaped by our relationship to and experience of landscape, material objects, and other people, and by our historical perspective of engaged landscapes, such that a change in any one of these variables will likely also result in a change in systems of belief and preunderstandings about the world. Such changes in worldview are likely signaled by major alterations in land-use and the experience of places based on frequency and nature of use, and are expressed in Wardaman Country through changing rock art styles among other things.

What stimulated these major changes in systems of land-use and place-use in Wardaman Country is not entirely clear, but one possible explanation is that overall population size waxed and waned, or used depending on changes in rainfall and inter-annual variability (Clarkson and Wallis 2003). The early Holocene optimum dated to between 9,000 and 6,000 years ago was manifested in northern Australia as wetter, more stable, and more productive environments that probably allowed bigger populations and more prolonged habitation and use of marginal land systems, such as those southern land systems containing large rockshelters. The later onset of severe El Niño events between 5,000 and 2,000 years ago may have seen contraction to better watered and more productive areas with less frequent use of poorer land systems under high-mobility regimes (Gagan, Chivas, and Isdale 1994; Gagan et al. 2004; Haberle and David 2004; Kershaw 1995; Koutavas et al. 2002; McGlone, Kershaw, and Markgraf 1992; Nott and Price 1999; Schulmeister and Lees 1995). El Niño events reduced in severity markedly 1,500 years ago, and populations perhaps made more use of marginal land systems again. The last 1,000 years saw diminishing use of the landscape again as El Niño settled into its modern pattern, with very high interannual variation still characterizing the region today (Dewar 2003). People consolidated territorial boundaries to protect critical resources at these times of greater subsistence risk, giving

![Figure 48.4 Changes in occupation intensity and the deposition of ochre averaged from four rockshelters (Nimji, Garnawala 2, Gordolya, and Jagoliya).](image-url)
as territorial markers (cf. David and Chant 1995; David and Lourandos 1998; Haberle and David 2004), as well as initiating extensive formal intergroup networks as social storage mechanisms to offset risk, giving rise to long-distance exchange networks that reified social relationships (Cashdan 1985; Myers 1982; Paton 1994).

**Conclusions**

Landscape has become an important methodological and theoretical concern in contemporary archaeology, and analysis of patterns of lithic transportation, accumulation, association, and alteration provide an important means of exploring past cultural landscapes that should form a central component of any serious landscape study. Stone artifacts stand to shed a great deal of light on many facets of human engagement with landscape, including: mobility; occupational intensity; the nature of planning and anticipatory provisioning for use of different land systems; experience of landscape; worldviews; and broader social relationships. The case study highlights the ways various threads of at regional scales and the ways these can be woven with other lines of evidence to create detailed studies of past human land-use, the shifting nature of place use histories, and people's social and economic engagement with places as environments, technologies, and social systems changed.

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