ADDITIONAL ARCHAEOLOGICAL SURVEYS IN THE OLD RIVER BED DELTA, DUGWAY PROVING GROUND, UTAH: THE SOUTHWESTERN CHANNELS

Dave N. Schmitt, David B. Madsen, David Page, and Geoffrey M. Smith

Utah SHPO Project No. U-06-DA-1367m

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By

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Submitted to:

Directorate of Environmental Programs
U.S. Army Dugway Proving Ground
Dugway, Utah 84022

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COVER PAGE
Must Accompany All Project Reports Submitted to Utah SHPO

State Project No.: U-06-DA-1367m

Project Name: Old River Bed Delta 2006: The Southwestern Channels

Report Date: February 23, 2007 **County(ies):** Tooele

Principal Investigator: David B. Madsen, and David Rhode

Field Supervisor(s): David B. Madsen, Dave N. Schmitt

Records search completed at what office(s)? Dugway Proving Ground – Cultural Resources

Record search date(s): September 11, 2006

Area Surveyed – Intensive (*≤15 m intervals*): ___633.07__ **acres** **Recon/Intuitive** (*>15 m intervals*): ___0___ **acres**

7.5' Series USGS Map Reference(s): Granite Peak NW, Utah; Granite Peak, Utah; Dugway Proving Ground NW, Utah

SITES REPORTED	COUNT	SMITHSONIAN SITE NUMBERS
Archaeological Sites	13	(42To) 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951 2952, 2953, 2954, 2955
Revisits (no inventory form update)	0	
Updates (updated IMACS site inventory form attached)	0	
New recordings (IMACS site inventory form attached)	13	(42To) 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951 2952, 2953, 2954, 2955
Total Count of Archaeological Sites	13	(42To) 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951 2952, 2953, 2954, 2955
Historic Structures (USHS 106 site info form attached)	0	
Total National Register Eligible Sites	7	(42To) 2945, 2947, 2948, 2949, 2951, 2953, 2955

Checklist of Required Items, attached

1. X Copy of the final report
2. X Copy of 7.5' Series USGS map with surveyed/excavated area clearly identified
3. Completed IMACS site inventory forms
   - X Parts A and B or C
   - X IMACS Encoding Form
   - X Site Sketch Map
   - X Photographs
   - X Copy of the appropriate 7.5' Series USGS map with site location marked and Smithsonian site number clearly labeled
4. X Completed "Cover Page" accompanying final report and survey material

For UDSH office use only

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Introduction

In late March of 2006, archaeologists and geomorphologists from the Desert Research Institute (DRI) and Kansas State University examined exposed Old River Bed (ORB) channels on the southwestern margin of the ORB delta in Dugway Proving Ground (DPG) in order to characterize their form and approximate age. Between September 10 and 19, 2006 a team of DRI archaeologists returned to conduct a cultural resources survey of 633 acres to map and record archaeological sites associated with these ancient deltaic features (Figure 1). Based on previous studies of the ORB (e.g., Madsen et al. 2006; Schmitt et al. 2002a, 2003), combined with survey results from selected cultural resource projects in its vicinity, we hypothesized that it might be possible to trace exposed, topographically inverted channels evident on the mudflats onto the uneroded underflow fan deposits of the ORB delta and to identify undisturbed sites along these channel margins. Identification of Pinto-age sites on the uneroded fan dating to the last phase of ORB stream flow (Page et al. 2003), together with faint traces of channels evident in air photos and orthophoto quadrangles suggested that such significant sites might exist and should be identified and evaluated for management purposes. All encountered cultural resources were recorded in detail and evaluated incompliance with the National Historic Preservation Act, the Archaeological Resources Protection Act, and Army Regulation 200-4.

The Old River Bed Delta

During the regressive phase of the last major high stand of Lake Bonneville the ORB held a river connecting the two major sub-basins of the Bonneville Basin. Beginning sometime before 12,000 ^{14}C B.P. (Godsey et al. 2005; Oviatt et al. 1992), the river ran north, draining the southern Sevier Basin and emptying into the Great Salt Lake along its southwestern margin in what is now the Great Salt Lake Desert. Sometime after about 8800 B.P., water ceased to flow in the ORB (Oviatt et al. 2003) and environmental conditions along the channel began to approach those found at present. During the ~3,000 years of its existence, however, the water in the river fed a large marsh/wetland system at the ORB delta and supported a riverine environment along its length. This 3,000 year interval corresponds almost exactly to the earliest phase of human

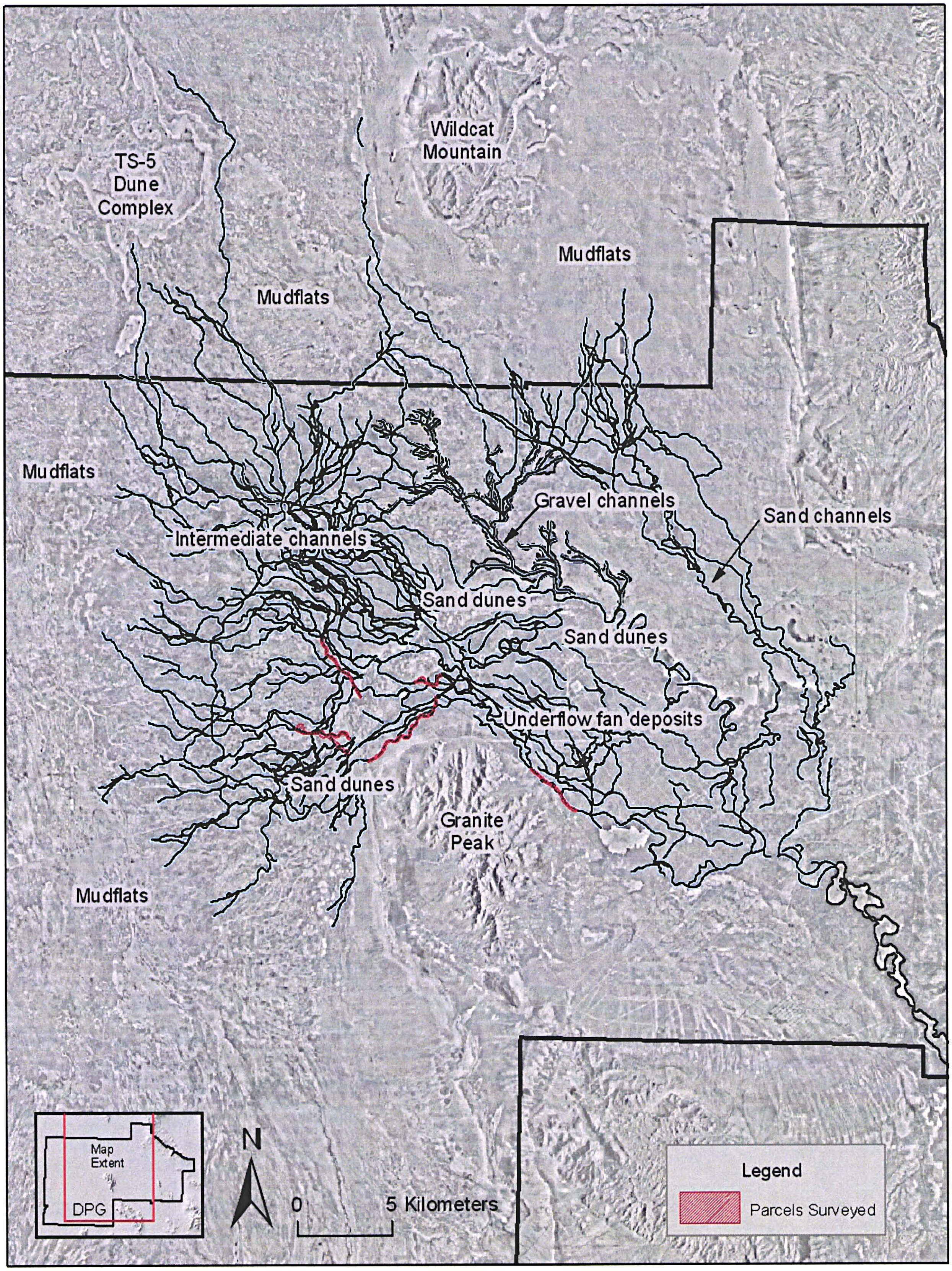

Figure 1. Location of survey parcels.

occupation in the Bonneville Basin (e.g., Grayson 1993; Schmitt and Madsen 2005 and references therein). Foragers have been drawn to these rich marsh/wetland ecosystems throughout the human history of the Great Basin (e.g., Fawcett and Simms 1993; Janetski and Madsen 1990; Madsen 2002; Raven and Elston 1988), but sites of the Paleoarchaic period are particularly associated with Great Basin wetlands (Elston and Zeanah 2002; Beck and Jones 1997; Jones and Beck 1999; Willig et al. 1988;). A paleoenvironmental project running concurrently with this archaeological evaluation is geared toward understanding and dating changes in the hydrological system which governed flow in the ORB. While some parts of these studies are not yet complete, some aspects relevant to human occupation of the delta are already evident (e.g., Madsen et al. 2000; Oviatt 1999; Oviatt and Madsen 2000; Oviatt et al. 2003; Schmitt et al. 2002a; see also Arkush and Pitblado 2000).

The primary geomorphic features of the ORB delta consist of the delta itself, mud flats to the north of the delta, and a series of dunes which mark the transition between the two. Two major hydrologic features within this setting have been identified, and have been informally referred to as "gravel channels" and "sand channels" (see Figure 1). Gravel channels are deposits of coarse sand and gravel that have a curved, slightly meandering, digitate form on the mud flats at the north end of the ORB delta. They are topographically inverted and are identified as fluvial in origin by their plan-view form, the composition of the gravel, and their longitudinal profile. In vertical profile these gravel channels range from low (~20 cm) eroded features to pronounced, readily visible features exceeding 2 m in height. Sand channels are not topographically inverted (except where they have been protected by dune formation) and are generally flush with the mud flat surface. In some areas curved depressions mark the paleochannels, and subtle ridge and swale topography is visible. They exhibit flood-plain morphology, with multiple point-bar sands and meandering patterns. Sand channels are filled with fine to coarse, cross-bedded sand. Abandoned channels and oxbows contain mud, organic debris, and abundant mollusk shell.

Additional channel forms, transitional between sand and gravel channels, as defined, have been informally referred to as “intermediate channels”, which are straighter and broader in width than sand channels and locally contain some gravel. These channel forms can be traced north, through DPG and the Utah Test and Training range, to altitudes as low as 1,285 m in the west-central Great Salt Lake Desert. Most of these intermediate channel forms originate on the far western edge of the uneroded delta margin (see Figure 1).

The ORB delta is composed, at least in part, of silts and clays in an underflow-fan deposited on the bottom of Lake Bonneville after the lake regressed below the ORB threshold and the ORB river began to dump fine sediment into the lake. As the lake regressed across this underflow-fan, it prograded to the north, wave action cut a relatively flat surface across its top, and the river channel was incised increasingly deeper into the fan as the lake level dropped. During this initial regressive phase, the water in the river was probably derived from overflow from the Sevier Basin (and, by extension, from the Sevier and Beaver rivers) and the current in the river was sufficient to support a high sediment load, including coarse sands and gravels in the deeper and swifter current. Sometime prior to 10,000 ^{14}C B.P., stream flow in the river was substantially reduced, and, as the lake retreated to the north, the river ceased to empty into it. By the time the gravel channels had stopped forming, the lake had dropped to an elevation of 4,260 ft (1,300 m). After 10,000 ^{14}C B.P. stream flow in the lower ORB increased. Whether or not this increased flow was due to overflow from the Sevier basin or from groundwater sources along the ORB channel is not yet clear, but it was substantial enough to carry coarse sands in channels 4-5 m wide and 2-3 m deep.

The age of the sand channels is relatively well controlled by seven ^{14}C dates directly on materials in the channels and eight dates on marsh/wetland deposits associated with the channels (Oviatt and Madsen 2000). These 15 radiometric dates place the formation of the sand channels between about 9800 and 8800 years B.P. The age of the gravel channels is less clear, but they appear to have formed between about 12,500 and 10,200 years B.P. Eight additional dates from marsh/wetlands not directly associated with either gravel or sand channels fall between about 11,400 and 10,000 years B.P. Three of these are associated with material representing shallow/stagnant water in the fill of an abandoned gravel channel in the flat underflow fan upstream from the exhumed channels. These dates suggest water continued to flow in the gravel channels, albeit at a possibly reduced rate, until about 10,200 years B.P. Shortly prior to the end of the gravel channel phase, however, water flow increased even as Lake Bonneville reached its lowest levels at ~1,300 m (4,265 ft). This higher flow river produced wider and deeper gravel channels that cross-cut earlier channels in a number of places, forming shallow ponds. Archaeological sites around at least two of these ponds, one of which we informally are calling

Lake Öferneet (see Figure 1), may be associated with the very end of gravel channel flow. The remains of Utah chub in the sand channels suggest some water continued to flow in the ORB between formation of the gravel and sand channels.

After ~8800 years ^{14}C B.P., deflation of the mud flats accelerated. This deflation exhumed the gravel channels and partially exhumed the sand channels, and may be related to the proximity of the water table to the surface. Both the ground surface and the water table slope to the north/northwest across DPG, but the ground surface slopes more steeply, and the two surfaces intersect. The intersection is marked by the sharp boundary between the mud flats and the flat plain covered with vegetation stripes. This boundary rises in elevation from about 1,300 m (4,265 ft) directly west of Granite Peak, to about 1,312 m (4,305 ft) near Baker, and is marked by sand dunes along its course. The mud flats are a landscape that is actively undergoing denudation through several processes. The mud is moistened by ground-water discharge, which probably occurs continuously, but the surface dries out during the hot summer when evaporation far exceeds the ground-water discharge rate. This wetting and drying causes the mud to swell and shrink, and to pelletize, thus creating loose particles that can easily be entrained by the wind and removed. The larger particles accumulate in dunes at the mud flat margin, and the smaller particles are blown much farther. Salt precipitation at the ground surface may contribute to the break-up of the mud. Shallow films of water also accumulate on the mud flat surface after heavy rains and are agitated by the wind, thus loosening particles that are easily deflated when the surface dries.

The dunes along the margin between the delta plain and the mud flats thus likely formed some time during the early middle Holocene, and have probably been in place since then. Exposures within the dunes suggest they have been stabilized a number of times during this period. While these periods of stabilization are not yet dated, they may correspond to periods of increased precipitation at ~6000, ~3400, and ~1000 years B.P. (Madsen 2000).

Based on results from a survey conducted in 2005 (Madsen et al. 2006), it is evident an extremely complex array of sand and intermediate channels occur on the southwestern portion of the delta south of the gravel channels.

These clearly post-date the deposition of the gravel channels, but their exact age is unknown. Most likely, they formed after the Gilbert stage of Lake Bonneville, but it is possible that several of the intermediate channels may pre-date Gilbert, and that wave action associated with the transgression and regression of the lake during Gilbert times (e.g., 10,500-10,100 ^{14}C B.P.) eroded much of these channel deposits. Due to the number and complexity of these cross-cutting distributary systems, we have attempted to gain some understanding of their relative age by color-coding the main systems and identifying where they intersect each other.

To date we have identified 18 primary intermediate and sand channel distributary systems on the southwestern margin of the ORB delta (Figure 2). Additional channels were identified north and east of the primary 'Black' gravel channels but these will not be discussed here. From north to south (southwest of the primary 'Black' gravel channels) these are "Light Blue", "Light Green", "Mango", "Brown", "Red", "Fuchsia", "Buff", "Royal", "White", "Green", "Blue", "Lime", "Pink", "Coral", "Yellow", "Lavender", "Orange", and "Navy". Based on indications of channel cross-cutting and channel morphology, the apparent relative ages, from oldest to youngest are: Black (gravel channels A_1/A_2, C_1/C_2, B), Blue, Fuchsia, Mango, Green, Royal, Buff, Red, Brown, White, Light Blue, and Light Green. The relative age of Mango and Royal to Green is presently unknown. There is a disparity in the relationship of the channels north of Blue and south of Yellow (with the exception of Black), as no channels cross each other and no absolute dates have been obtained from the Blue distributary system. The southern channels (south of Blue) were ranked by cross-cutting relationships (in relation to Yellow) and the apparent relative ages, from oldest to youngest are: Yellow, Lavender, Orange, Navy, Coral, Pink, and Lime. The relative age of Pink to Lime is unknown, as is the relationship of Navy (older than Orange) to Coral, Pink, and Lime. Several distal channels related to the 'Black' gravel channels exit the uneroded fan and are cut by Light Green, Brown, and White in the north and to the south are cut by White, Green, Blue, and Yellow.

We obtained AMS age estimates on carbonized plant remains in organic "black mats" associated with the Yellow and Lavender channels. These indicate that our relative age estimates are accurate, as organics in the Lavender channel date to 9010 ± 40 B.P. and the sample from the Yellow channel returned a date of 10,130 ± 80 B.P. In addition, chronologically diagnostic formal tools identified on sites associated with the Yellow and Lavender channels suggest that the Yellow channel system is older. Sites on the Yellow channel contain only Great Basin Stemmed point variants, while sites on the Lavender channel contain some Pinto or Pinto-like points dating to the end of the ORB sequence. The identifiable plant materials in the Yellow and

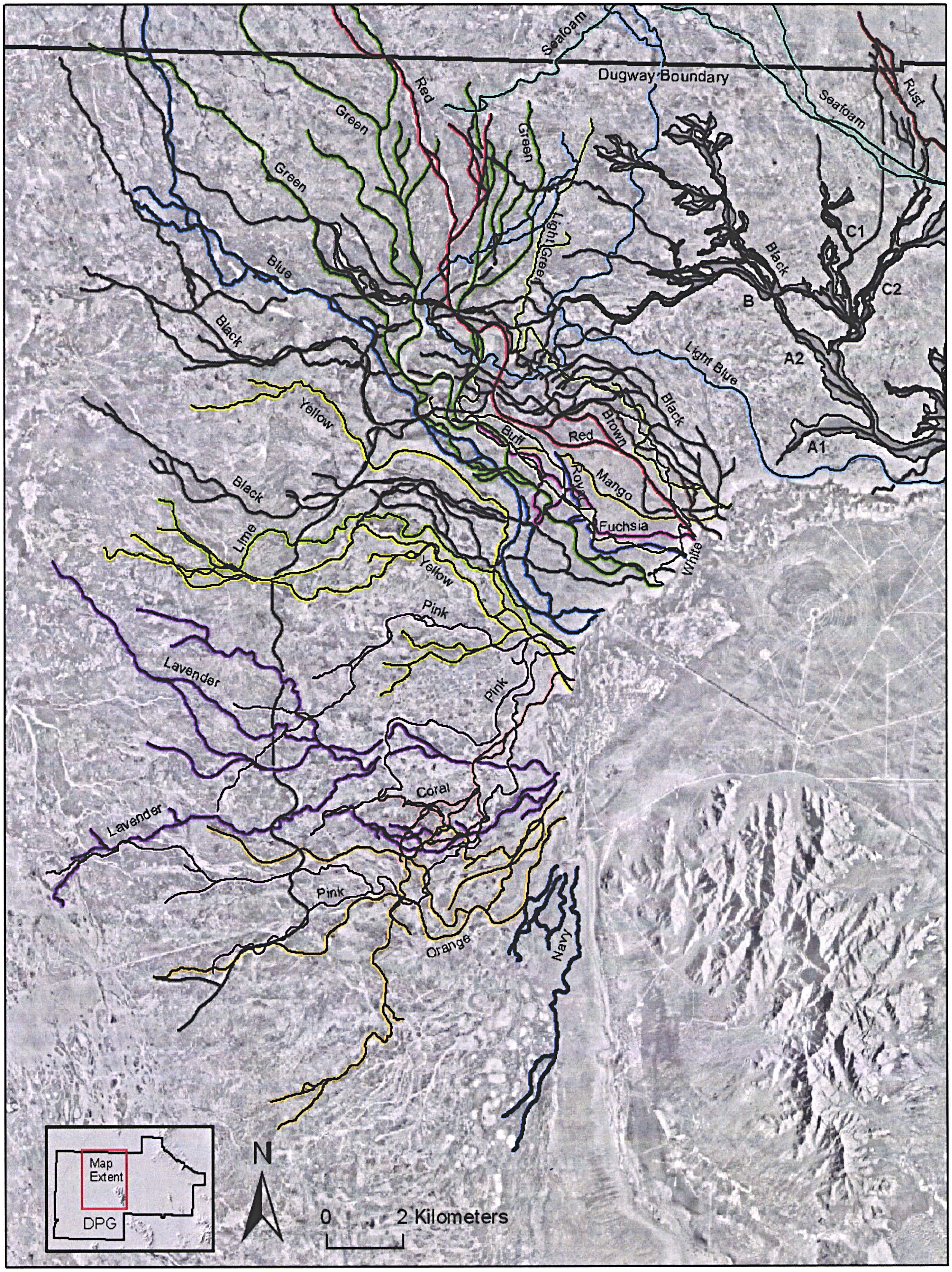

Figure 2. Detail of eroded channel features in the southwestern ORB delta.

0 1.24mi

Lavender channel black mat samples were identified to the species level as bulrush (*Scirpus* sp.) suggesting that water in the channel(s) was shallow/slow moving and likely brackish within a low energy marshy system.

Inventory Parameters

To investigate the probability that Paleoarchaic/Early Archaic sites occur in the ORB delta, the Directorate of Environmental Programs at DPG and the Utah Geological Survey entered into a cooperative agreement to evaluate survey tracts in the ORB delta. The delta, almost in its entirety, lies within the confines of DPG, as do approximately 15 km of the lower ORB channel. A large number of projects, conducted in accordance with the DPG mission, occur annually in the delta area, and these have the potential to impact significant archaeological sites, particularly critical and relatively rare sites dating to the Paleoarchaic Period. Inventories conducted under this 1999-2002 cooperative agreement were initiated to identify such sites and to evaluate their significance (Madsen et al. 2000; Schmitt et al. 2002a). In 2003, DRI personnel continued archaeological and geomorphic investigations in the delta, including two additional surveys (Madsen et al. 2006; Schmitt et al. 2003) and limited test excavations (Madsen et al. 2004). Here we present the results of the fifth phase of ORB investigations where an additional 633 acres were inventoried in six survey tracts (see Figure 1) to the south and southwest of these previous projects.

In addition to these management concerns, the initial survey (Madsen et al. 2000) encountered a number of relatively pristine Paleoarchaic sites in the delta area and we were confident that others awaited discovery. Most major wetlands in the Great Basin lie at the end of major river systems, such as the Humboldt, Bear, and Carson Rivers, and have been in existence for at least the period of human occupation in the region. As a result of both continuous use of these marshes by foragers and erosional/depositional cycles associated with Holocene climatic changes, intact Paleoarchaic sites are relatively rare (e.g., Raven 1990; Raven and Elston 1988). The ORB delta differs in that it was forming for only a limited time during the Paleoarchaic Period and, while erosion has taken place since that time, there has been no movement of the marsh ecosystem back-and-forth across the landscape which would result in the disturbance of early sites. Moreover, as warmer and drier Middle Holocene climates took hold just prior to

8000 B.P. (e.g., Huckleberry et al. 2001; Madsen et al. 2001; Schmitt et al. 2002b), the area became relatively unattractive to hunter-gatherers and the impact that human activities generally have had on early sites in most major wetland systems was probably much more limited. In addition, DPG has been closed to the general public for more than 50 years, and disturbance by relic hunters has likely been less than that found outside the installation boundaries.

In addition to these issues, newly available color air photos suggested that it might be possible to identify channels on uneroded portions of the ORB delta by evaluating differences in the vegetational cover. Pinto-age sites dating to the latter portion of the ORB sequence have also been recently identified in the vicinity of where these unexposed channels might occur (see Page et al. 2003). Together these new data suggested the possibility that the location of buried Paleoarchaic sites could be plotted with a reasonable degree of probability. To this end, we used air photos and attempted to trace southwestern ORB channels evident on the mudflats onto the uneroded portion of the delta (Figure 3). These were then converted to GPS coordinates, allowing us to survey probable channel locations not evident from surface observation. Pedestrian surveys were then conducted on segments of several southwestern channels on both the eroded and uneroded portions of the delta to confirm or reject this hypothesis.

Previous Investigations: A Class I Overview

A Class I literature review was conducted at the office of Rachel Quist, DPG Cultural Resource Manager, on September 11, 2006. Twenty-nine survey projects have been conducted within two miles of the 2006 ORB project area (Table 1), together encompassing approximately 9,454 acres. Sixty-three archaeological sites including 49 prehistoric sites and 14 historic sites have been identified during the projects in the vicinity of our study area, including 17 sites that have yet to be formally evaluated. Of the remaining 46 sites, ten (42To1180, 42To2064, 42To2065, 42To2097, 42To2098, 42To2141, 42To2146, 42To2148, 42To2152, and 42To2345) have been identified as significant properties eligible for NRHP inclusion. Additionally, 14 sites (42To0389, 42To0390, 42To0394, 42To2551, 42To2552, 42To2553, 42To2554, 42To2555, 42To2556, 42To2557, 42To2558, 42To2559, GPI2-Part 1 and GPI2-Part 2) have been determined to be potentially eligible for NRHP inclusion.

Forty-five of the sites contain temporally diagnostic artifacts and the remaining 18 are prehistoric lithic scatters of unknown age. Sites containing diagnostic Paleoarchaic artifacts (n = 12) include 42To0394, 42To2551-42To2559, 05-ORB-15, and 05-ORB-16. Sites dating to the Archaic Period (n = 14) include 42To1689, 42To2141, 42To2145, 42To2146, 42To2148, 42To2149, 42To2152, 42To2170, 42To2172, 42To2173, 42To2345, 42To2346, 42To2349, and 42To2352. One single-component site dating to the Fremont Period, 42To0388, was recorded within two miles of the current project area, as was one Late Prehistoric site (42To1180). Fifteen sites containing Euro-American artifacts (42To0390, 42To2144, 42To2669, 42To2710, 42To2711, 05-Dorado1, 05-Dorado2, 05-Cannon1, 05-LHPipe1, 05-LHPipe2, 05-GP-01, 05-GP-07, 05-GP-08, 05-GP-09, and 05-GP-11) have been identified. Finally, one multi-component site, 42To2065, was recorded in the vicinity of the 2006 ORB project area. It contains diagnostic artifacts from both the Archaic and Fremont periods.

Table 1. Projects and identified sites within two miles of the Current ORB Survey Parcels.

Project No.	Area (acres) Surveyed	No. Sites	*No. Eligible	Report Reference
U-84-MA-1063m	243.99	6	3	Zier 1984
U-90-BC-0053m	13.07	0	0	Billat 1990a
U-90-BC-0153m	22.06	0	0	Billat 1990b
U-90-BC-0371m	4.74	0	0	Christensen 1990a
U-90-BC-0543m	1.59	0	0	Christensen 1990b
U-93-HL-0246m	87.93	0	0	Weder 1994a
U-94-HL-0122m	21.03	0	0	Weder 1995
U-94-HL-0191m	4.84	0	0	Weder 1994b
U-94-HL-0794m	1.5	0	0	Weder 1994c
U-97-DU-0467m	4.72	0	0	Callister 1997
U-99-DU-0211m	759.48	4	1*	Madsen et al. 2000
U-00-DU-0684m	1.4	0	0	Callister 2000
U-01-DU-0303m	547.07	1	0	Schmitt et al. 2003
U-01-DU-0783m	16.03	0	0	Quist 2002a
U-02-DU-0228m	16.41	0	0	Quist 2002b
U-02-DU-0486m	7.26	0	0	Quist and Callister 2002
U-03-DA-0514m	1028.16	3	1*	Page et al. 2003a
U-03-DA-0570m	3053.88	12	3*	Page et al. 2003b
U-03-DU-0311m	211.39	4	4*	Quist 2003a
U-03-DU-0542m	26.05	1	0	Quist 2003b
U-03-DU-0827m	2.47	0	0	Quist 2003c
U-04-DA-0777m	1703.74	6	1*	Schmitt and Page 2004
U-04-DU-0256m	98.34	0	0	Quist 2004
U-05-DU-0498m	979.43	11	9	Madsen et al. 2005
U-05-DU-0602m	221.27	3	0	Quist 2006a

Table 1. Continued.

Project No.	Area (acres) Surveyed	No. Sites	*No. Eligible	Report Reference
U-05-DU-1158m	98.19	0	0	Quist, in progress
U-05-DU-1159m	221.97	0	0	Quist 2006b
U-05-DU-1301m	40.04	0	0	Quist and Rust 2006
U-06-DU-0342m	42.34	0	0	Quist, in progress

Asterisks denote SHPO concurrence.

Field Methods

Using aerial photography we selected sections of the Yellow and Lavender channels to survey in order to characterize the nature of sites associated with these features on the eroded mudflats. Previously (Madsen et al. 2006), we surveyed portions of the Green and Blue channels and have some understanding of sites along these channels. Based on apparent differences in vegetation, we also plotted what we think are sections of the Blue and Orange channels in the uneroded area of the ORB delta (see Figure 3). These channel sections on the eroded and uneroded portions of the ORB delta were then surveyed using the following methods.

The project area was investigated by DRI archaeologists comprised of a five-member crew. Survey tracts were completely covered by parallel transects; the underflow fan parcels were investigated via pedestrian survey and reconnaissance of the eroded mudflats included walking and survey from ATVs at low speeds. Regardless of technique, the spacing interval varied between 10 and 20 m depending on the amount of vegetation cover. When surface artifacts were encountered, the area in the immediate vicinity of the surface materials was examined at closely spaced intervals not exceeding 2 m. Cultural materials were defined as a site or as an isolated find based on this detailed examination. Our criteria for site assignment were four or more artifacts within a 10 m diameter area. Tools in situations not matching these criteria were recorded as isolated finds. Materials younger than 50 years were not recorded. When encountered, sites were carefully examined to determine the spatial extent of the artifact scatter, as well as to identify all tools and other cultural features, such as pits or fire hearths, evident on the surface. The site boundaries were identified and orange plastic datum stakes were driven into

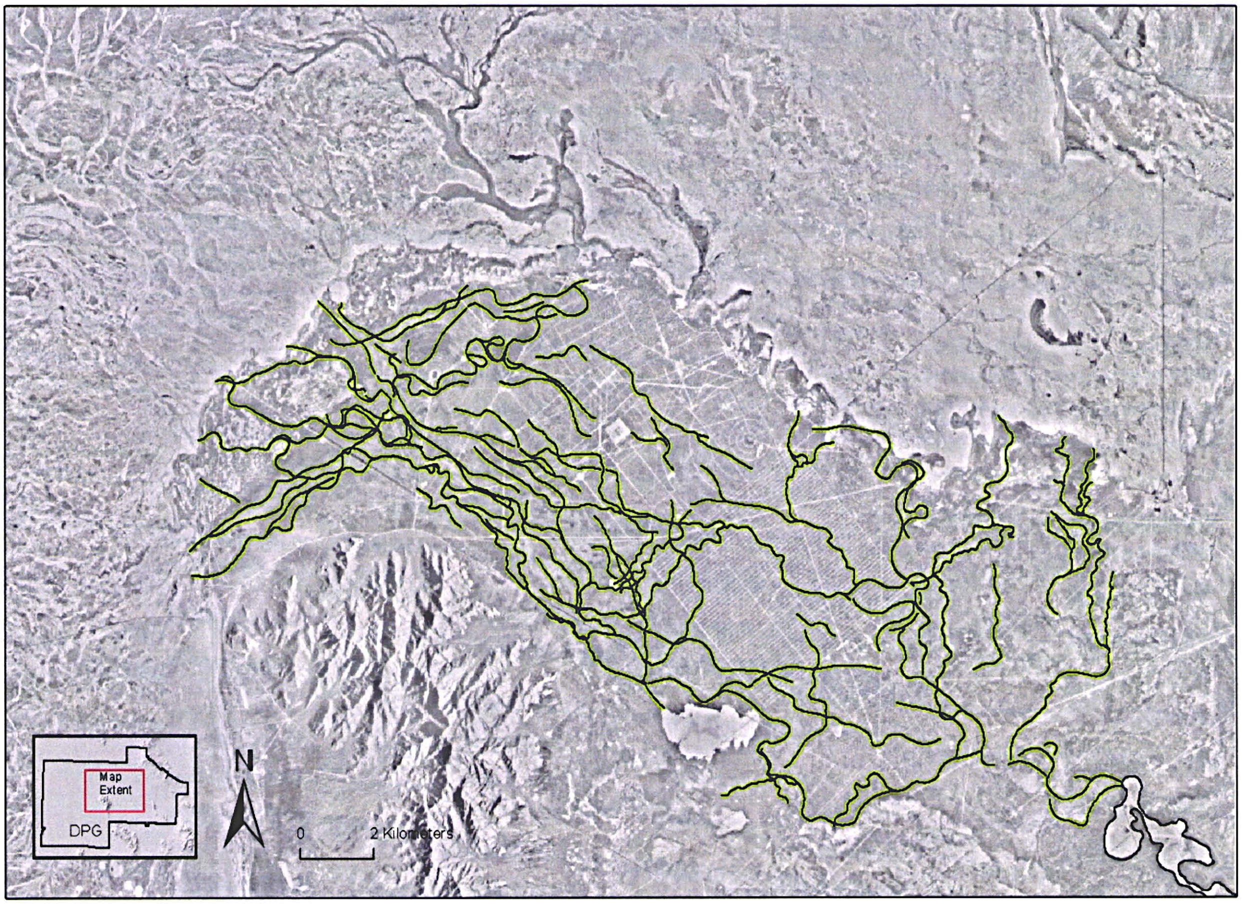

Figure 3. Detail of uneroded channel features in the southwestern ORB delta.

the approximate middle of each site. Site locations were determined by taking and recording a GPS reading at each of these datum marker posts.

Relevant data on the local ecological setting, geomorphology, degree and kind of disturbance, apparent cultural features, diagnostic artifacts, etc., were recorded on IMACS site forms especially modified for use at DPG by the Cultural Resources Manager, Directorate of Environmental Programs. These written forms were then used as the basis for filling out IMACS encoding forms. Provenience and descriptive information was recorded for isolated finds on special forms created for that purpose by DPG cultural resource management personnel. A detailed map of each site was constructed by taking and recording GPS readings at formed artifacts, cultural features, and site boundaries. Individual flakes in diffuse scatters were characterized (e.g., decortication, secondary interior) and mapped with a portable GPS unit. Discrete concentrations of flakes and/or lithic tools were identified as loci. These loci were described, boundaries were plotted and, when present, any formed tools within a locus were individually mapped and collected. Where pertinent, a series of GPS readings were taken on, or along the margins of, primary geomorphic features (e.g., dune margins, channels) within and immediately adjacent to site boundaries. All coordinate data was collected using a Trimble ProXRS global positioning system (GPS) receiver using satellite real-time differential (DGPS) corrections. Data was exported and recorded using the Universal Transverse Mercator (UTM) projection 11 North, NAD 27, measured in meters; altitude was measured from Mean Sea Level.

Each site was photographed from two or more angles and specific features were photographed where relevant. All identifiable artifacts were pin-flagged prior to both photography and mapping to ensure that site dimensions and features were accurately recorded. All diagnostic artifacts and a sample of lithic tools were collected from each site at the request of the DPG cultural resource management team. A GPS reading was taken at the location of all collected artifacts and recorded as a UTM grid point. Where possible, named artifact types were identified and recorded in the field.

Parcel and Site Descriptions

Six survey parcels were judgmentally selected for archaeological inventory based on their relationship to ORB deltaic features as seen on the ground and on high resolution air photos. Surface reconnaissance on and adjacent deltaic channels in these areas identified 13 prehistoric sites, all of which occur on or near channels on the alkali mudflats. The following presents brief descriptions of the survey parcels and identified archaeological sites. Detailed information on each recorded site, including all plan maps, photographs, and lists of collected artifacts can be found in the IMACS site forms attached as Appendix A. Locations and descriptions of isolates (n = 24) are presented in Appendix B.

Underflow Fan Parcels

Three parcels were examined via pedestrian survey along channel features in uneroded fan deposits north and east of Granite Peak (Figures 1 and 4). Parcel 1 is a linear 63

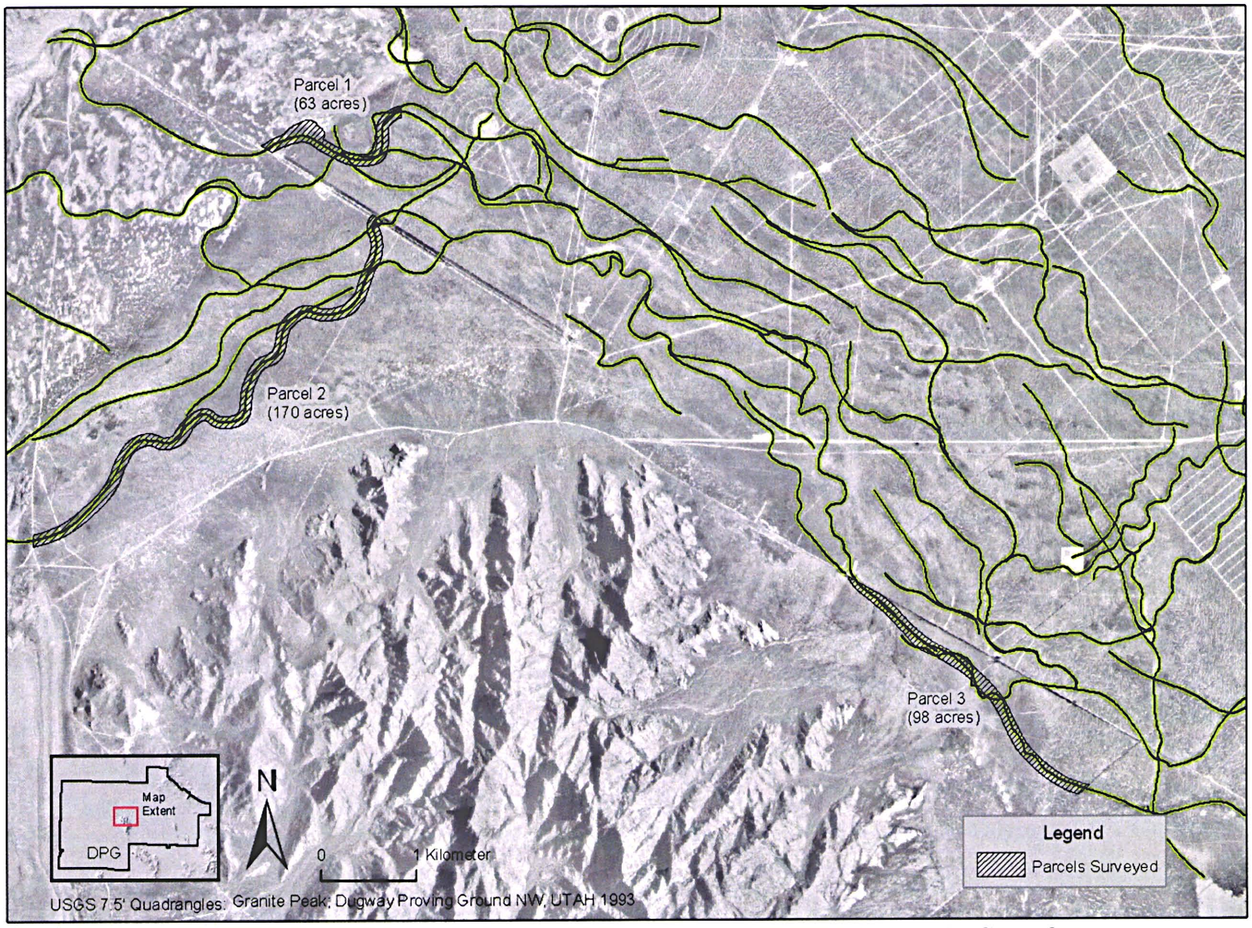

Figure 4. Location of survey parcels 1-3 on the uneroded underflow fan.

acre tract encompassing a short segment of the Blue deltaic channel that runs ca. 1.9 km north of Granite. Elevation across the parcel is ca. 4,280 ft. amsl. Vegetation consists of a xerophytic scrub community containing greasewood (*Sarcobatus* sp.), fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), snakeweed (*Gutierrezia sorthrae*), pepperweed (*Lepidium perfoliatum*), and some gray molly (*Kochia americana*). No cultural resources were identified in direct association with this segment of the Blue channel.

Parcel 2 is a 120 meter-wide, 170 acre tract encompassing approximately 5.7 km of the Orange channel. As is the case for Parcel 1, elevation across the parcel is ca. 4,280 ft. amsl. The tract spans from the dunes at the edge of the mudflats to the north end of Granite Peak. No cultural resources were identified in direct association with this segment of the Orange channel. Parcel 3 also incorporates a portion of the Orange channel. It is a 120 meter-wide, 98 acre tract encompassing approximately 3.2 km of channel east of Granite. Elevations on and adjacent to this channel range between 4,300-4,303 ft. amsl. Only a single isolate was identified in direct association with this segment of the Orange channel.

Mudflat Parcels

Three survey tracts were judgmentally selected to trace channel segments across the alkali mudflats. Parcel 4 is a 120 meter-wide, 133 acre tract encompassing approximately 3.2 km of the Lavender channel (Figures 1 and 5). The easternmost edge of the tract includes the fan-mudflat interface where linear Holocene dunes built atop this transition reach 4,317 ft. amsl. On the deflated mudflats, the exposed Lavender channels run west for more than 15 km. Elevations in our survey area on and adjacent to this channel range between 4,260-4,300 ft. amsl. The dunes support greasewood (*Sarcobatus* sp.), saltbush (*Atriplex* sp.), rabbitbrush (*Chrysothamnus* sp.) and a variety of grasses, and the channel and surrounding alkali flats contain a sparse pickleweed (*Allenrolfea* sp.) and seepweed (*Suaeda* sp.) community. Seven archaeological sites were identified and recorded in direct association with the Lavender channel.

To the south, Parcel 5 is another 120 meter-wide, 54 acre tract encompassing approximately 1.5 km of cross-channel survey of open mudflats, a portion of the Pink channel and two segments of channels directly related to the Lavender channel system (Figure 5). This parcel was included in our inventory while making our way back on foot to the uneroded portion of the Orange channel at the dune interface. Two archaeological sites were identified and recorded in direct association with southern distributaries of the Lavender channel system (Figure 6).

Approximately 2 km north of these tracts, Parcel 6 is a 120 meter-wide, 116 acre tract encompassing approximately 3.9 km of the Yellow channel (Figures 1 and 7). The southern end of the tract includes the fan-mudflat interface where linear Holocene dunes built atop this transition reach 4,280 ft. amsl. On the deflated mudflats, the exposed Yellow channels run west and northwest for more than 15 km. Elevations in our survey area on and adjacent to this channel range between 4,260-4,280 ft. amsl. Five archaeological sites were identified and recorded in direct association with the Yellow channel (Figure 8).

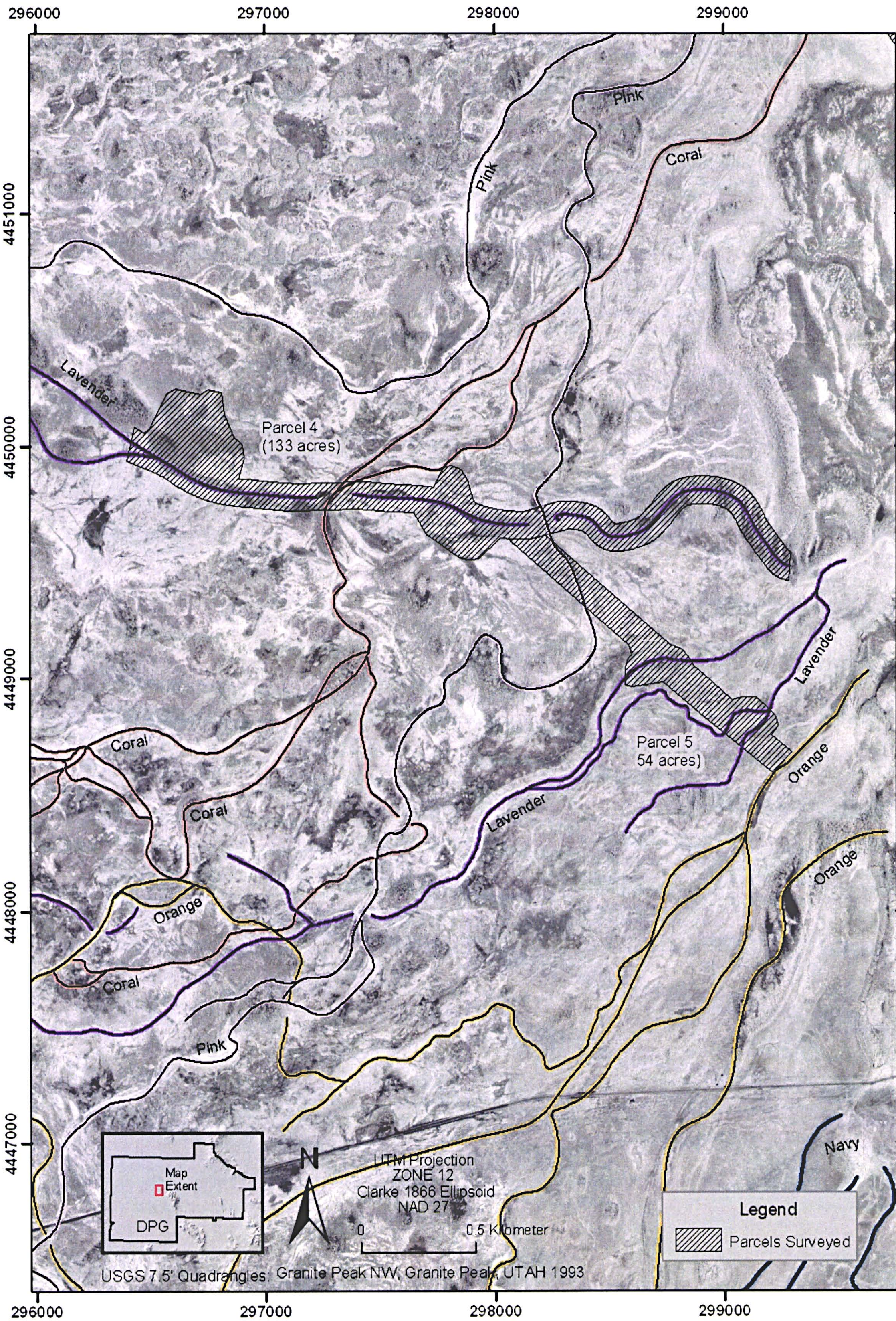

Figure 5. Location of survey parcels 4 and 5 on the alkali mudflats.

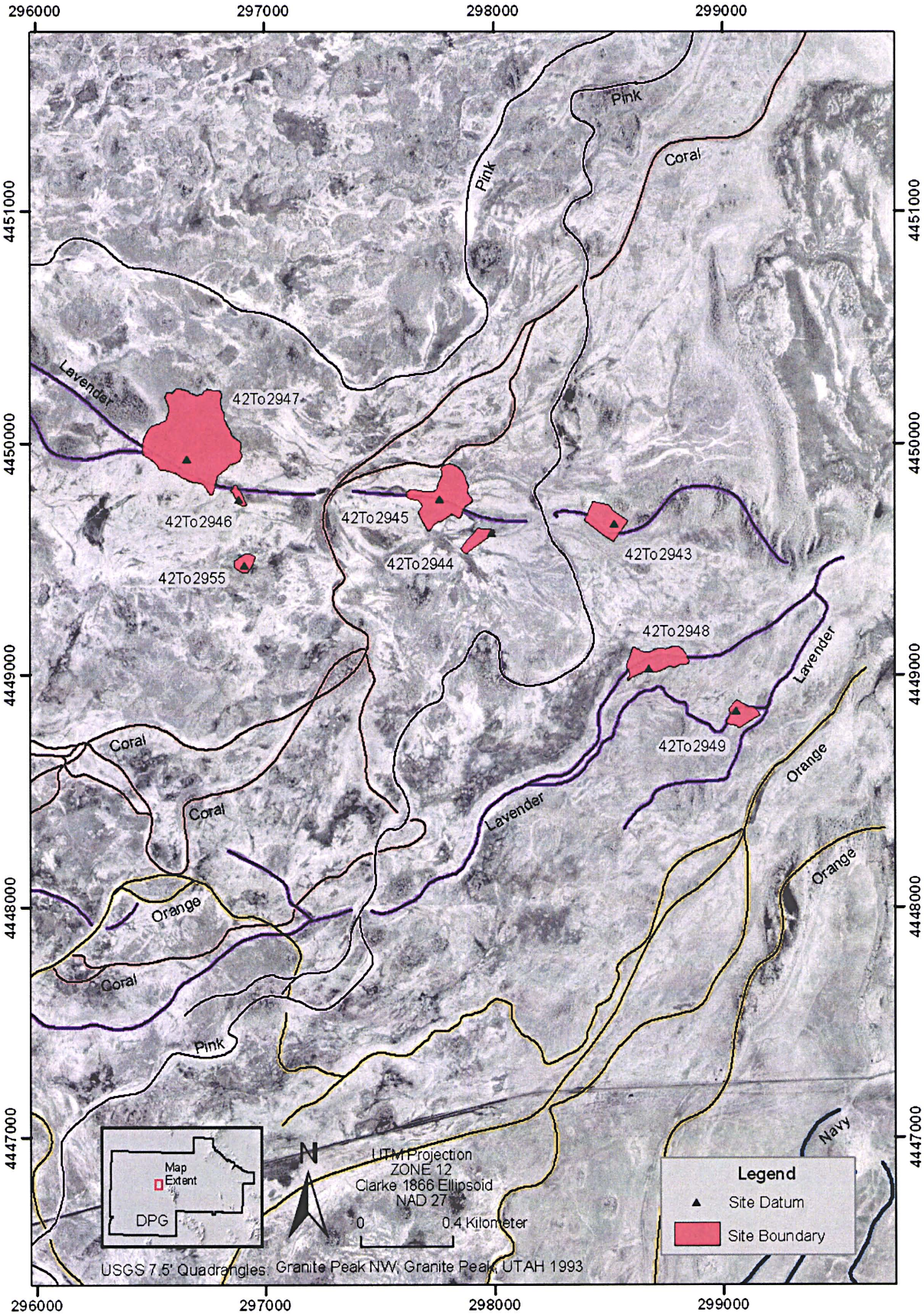

Figure 6. Location of identified sites on the eroded Lavender channel system and on the surrounding alkali mudflats.

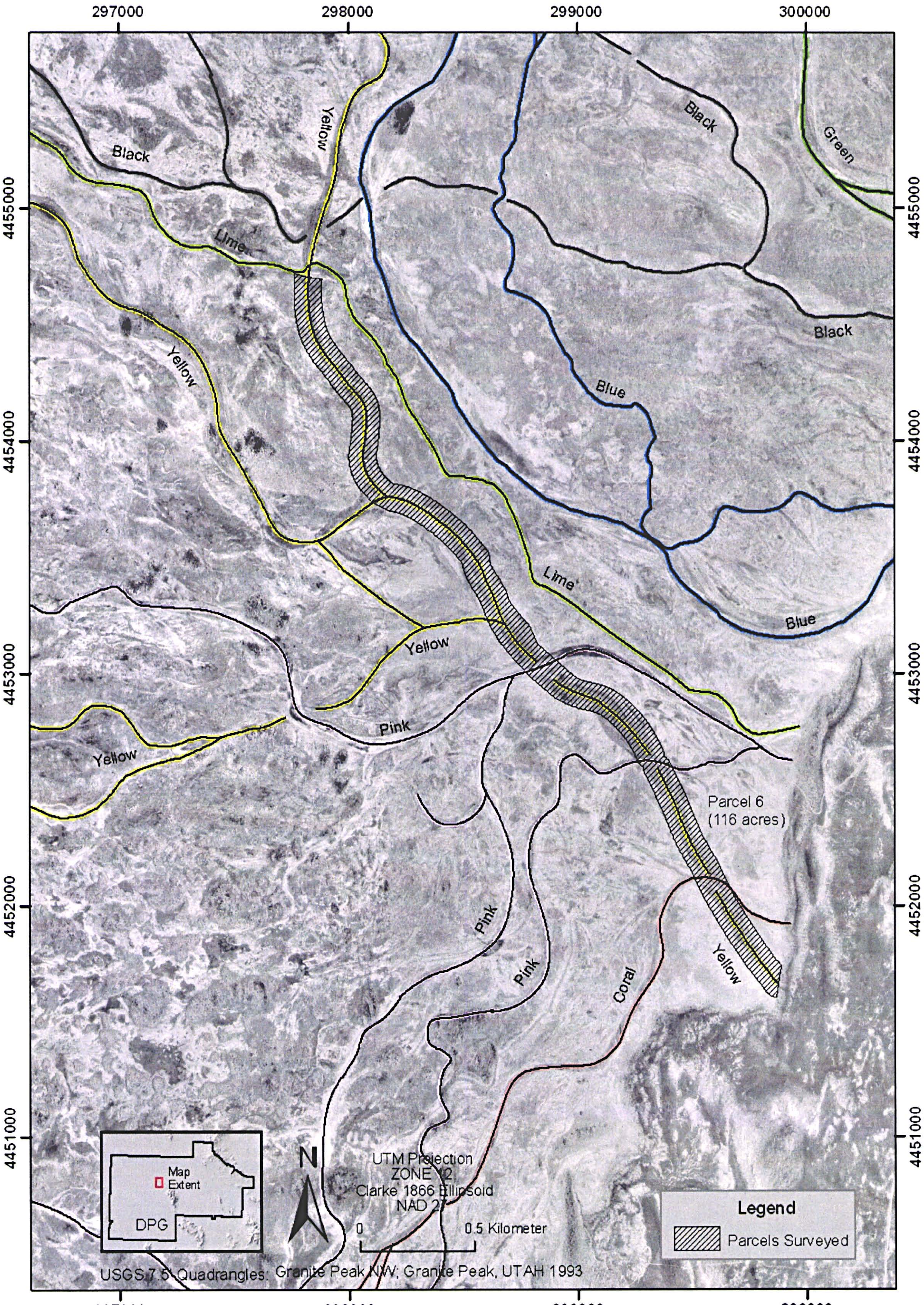

Figure 7. Location of survey parcel 6 on the alkali mudflats.

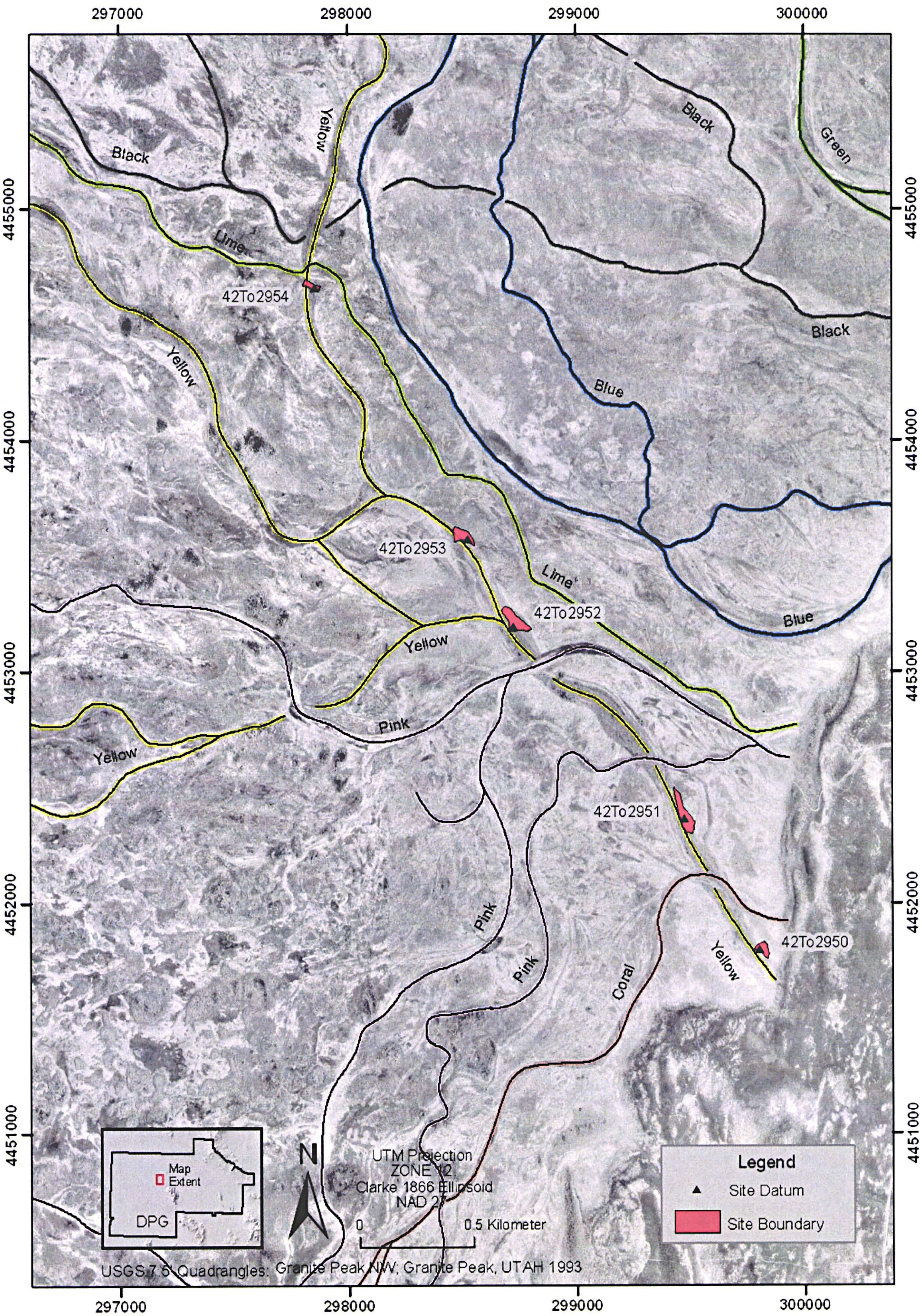

Figure 8. Location of identified sites on the eroded Yellow channel.

Site Descriptions

42To2943 consists of a relatively small, diffuse lithic scatter associated with the Lavender channel. It is on the inner bend of a channel meander that is grading to the south. A few flakes were observed atop the channel but most of the artifacts are scattered across the neighboring eroded mudflat surface. Approximately 25 pieces of debitage and 13 tools were observed, the former dominated by obsidian along with some basalt and a single CCS secondary flake. Overall flaking stages reflect some decortication and core reduction, but most of the detritus represent biface thinning debris. Tools include two Great Basin Stemmed points, four bifaces, and five unifacially modified flakes.

Site 42To2944 is an open lithic scatter containing two artifact clusters (Locus A and B) between migratory meanders on the Lavender channel. Locus A is the northeastern cluster and consists of a ca. 30 m-diameter area containing approximately 20 flakes and a few tools. To the southwest, Locus B also encompasses a 30m-diameter area and consists of 10-15 flakes. Both loci are dominated by obsidian and basalt biface thinning flakes. Other observed debitage include a CCS core reduction flake and a biface thinning flake, and one quartzite secondary flake. Regardless of context, most of the obsidian and basalt are extensively weathered from prolonged exposure. Eight lithic tools were observed and include three biface fragments – one of which may be the distal end (blade) of a Great Basin Stemmed point, a basalt scraper, and a couple of simple flake tools. An obsidian Pinto-like point suggests that occupation of the site was relatively late in ORB sequence.

42To2945 consists of an extensive array of lithic debitage and tools on the deflated mudflat surface between and on migratory distributaries associated with the Lavender channel. Lithic artifacts are widespread, but a few flake concentrations (Locus A and B) occur among the general low-density background. These concentrations occur in the low areas between the topographically inverted channels and, hence, it appears they were originally located on the channel margins; alternatively, it is possible that the current artifact distributions are a product of post-depositional processes, with artifacts moved by rain and wind into slight depressions on the generally flat surface. Overall, the site contains more than 1,000 lithic artifacts. The debitage is dominated by obsidian and basalt and includes biface thinning flakes (dominant) along with some shatter and decortication and secondary flakes that mark the primary reduction of cobbles and cores on some occasions. Tools include four scrapers, a basalt graver, a drill, 13 Great Basin

Stemmed points/point variants, three Pinto points, and a host of fragmentary bifaces and edge-modified flakes. Given the wealth of lithic artifacts, only the formal tools, loci boundaries, and general site boundaries were mapped.

Locus A is on what appears to be an older channel margin. It is a 15-20m diameter concentration of ca. 150 lithic artifacts located immediately southeast of the datum. Most of the observed flakes are weathered/patinated obsidian and basalt core reduction and especially biface thinning debris. Thirteen formal tools were observed in the concentration.

Locus B is a small linear array of lithic flakes and tools running north - south in a shallow depression flanked by two sand channels; similar to Locus A, it likely was on the channel margin. About 20 obsidian and basalt flakes were observed along with 10 formal tools.

Site 42To2946 is a small lithic scatter containing approximately 60 flakes and 11 tools. The lithic materials largely occur in a low area between topographically inverted sand channels. In this location, the sand channels extend as much as 50cm above surrounding mudflats. Although this tends to produce linear arrays of lithic material along what were probably channel margins, it is likely that the artifact distributions are a product of post-depositional processes where materials have slowly been transported into these lower areas over time. Like most sites in the ORB delta, lithic materials consist only of basalt and obsidian. Secondary interior (core reduction) detritus are most abundant, along with biface thinning debris and rare (one each) decortication flakes and shatter. Eleven tools were recorded, including five fragmentary bifaces, two modified flakes, and four Great Basin Stemmed points/point variants.

42To2947 consists of a very large and, in places, quite dense lithic scatter situated between major, topographically inverted sand channels of the Lavender distributary system. Due to its large size (~121,234 m^2) and because small dunes cover much of the channels/site, its exact context cannot be determined. Over 1,000 flakes occur and include obsidian, basalt, and sparse quartzite. To characterize the lithic detritus, a 2m wide by 80m long transect was established near site datum (see the 42To2947 IMACS site map). Ninety-six pieces of debitage were observed in this linear transect and consist primarily of obsidian flakes ($n = 87$) along with some basalt. Flaking stages reflect the entire reduction sequence (i.e., decortication through late-stage biface thinning) with core reduction and biface thinning debris most common. Interestingly, many of the obsidian artifacts here, and across the site as a whole, appear relatively unweathered and it may be that movement of the dunes across the site has only recently uncovered them.

Thirty-seven tools were plotted and characterized and include a basalt scraper, 14 biface fragments, a basalt Pinto point, 14 Great Basin Stemmed points/point variants, and a number of edge-modified flake tools. The low tool-to-debitage ratio at 42To2947 clearly indicates that tool production was common, and the diversity in projectile points suggests that a series of occupations occurred.

42To2948 consists of a linear array of lithic debris along the south 'Lavender' channel margin. The site measures ca. 120m wide by 280m long and trends northeast to southwest. Flakes and tools extend out into the neighboring mudflats some 5-10m and a thin scatter of lithic artifacts occurs on top of the channel in between the low dunes that cover most of channel proper, but most materials are near the channel margins. Although only the formal tools were mapped, all the debitage was characterized and tallied by material type. Of the 189 observed pieces of debitage, 138 are obsidian, 50 are basalt, and one is CCS. Obsidian core reduction and biface thinning flakes dominate the debitage, but basalt biface thinning and, to a lesser extent, core reduction flakes, also occur. Decortication flakes and angular shatter are present but rare at the site. A single CCS core reduction flake was also recorded. Obsidian flaking stages signal cobble/core reduction through the thinning of late-stage bifaces, and the basalt largely reflects biface thinning and occasional core reduction. Twenty-one tools were recorded and include three bifaces, 10 biface fragments, two simple flake tools, five Great Basin Stemmed points/point variants, and one obsidian Pinto point. A radiocarbon (AMS) assay of organic materials from black mat deposits in the Lavender channel returned a date of 9010±40 B.P. (Beta-221778). Although the result of this radiocarbon analysis dates organics deposited during the final stages of channel flow in the ORB delta, it also provides additional and important information regarding the timing of channel formations in the delta and, in turn, the earliest relative ages of associated archaeological sites, including 42To2948.

42To2949 is a linear artifact scatter containing numerous bifaces, projectile points, and edge-modified flakes. It is along a small, narrow Lavender channel distributary associated with the south Lavender channel system. Cultural materials occur along the distributary margin and extend away from the channel some 10-20m in some areas. Approximately 50 pieces of lithic debris were observed and include flakes of obsidian and basalt, and a single flake of quartzite. Relatively equal numbers of secondary and tertiary detritus indicate that both core reduction and biface thinning were common. Debitage is dominated by biface thinning flakes with a lesser number of core reduction flakes. Obsidian is the most common lithic raw material at the site, although basalt is also well-represented. Although most of the materials are atop a deflated mudflat surface, the presence of both weathered and "fresh" toolstone suggests that materials have been differentially exposed. Thirty-five chipped stone tools were recorded, including 13 biface fragments, ten Great Basin Stemmed points/point variants, and an array of edge-modified flakes.

42To2950 consists of a small lithic scatter on both sides of the main Yellow distributary channel. A linear array of 15-20 basalt and obsidian flakes occurs on both channel margins. Thirty-nine flakes were recorded, which consist primarily of basalt and obsidian core reduction and, to a slightly lesser extent, biface thinning flakes. Three lithic tools were observed: a bifacially modified obsidian flake, an obsidian biface, and a unifacially modified basalt flake. Overall artifact density is low and no diagnostic artifacts were observed, making it impossible to assign the site to a particular period of Great Basin prehistory.

Site 42To2951 is a diffuse lithic scatter on the northeast end of a gravel channel island of the Yellow channel. Thirty-eight tools and 54 pieces of debitage were recorded, all of which are either obsidian or basalt. Artifact density may have been greater as a collector/curious pile was found on the northwest edge of the site and it is likely that other artifacts have been removed. The main "concentration" of cultural materials is about 30m in diameter with a few flakes and tools occurring on the mudflats to the northeast of the channel. From this main concentration, artifacts extend downstream (to the northwest) in a linear fashion along the center of the topographically inverted channel. The observed debitage includes nearly equal numbers of secondary and tertiary flakes and it appears that core reduction and early-to-middle stage biface production were common. Tools include 19 bifaces/biface fragments, 11 Great Basin Stemmed points/point variants, and a few obsidian edge-modified flakes. Obsidian is the dominant raw material among the tools, while obsidian and basalt debitage occur in approximately equal frequencies.

42To 2952 consists of a long, sparse lithic scatter containing approximately 60 artifacts. It is oriented along a slightly topographically inverted, pea gravel-covered intermediate channel where the main distributaries of the Yellow channel split. The site is approximately 150m long by 40 meters wide with occasional flakes extending south 10-20m onto the neighboring eroded mudflats. Forty-two obsidian and basalt flakes were observed and include 20 core reduction flakes and 22 biface thinning flakes. Twenty tools including two utilized flakes, four edge-modified flakes, six fragmentary bifaces, and eight Great Basin Stemmed points/point variants, including a contracting stem type were recorded.

42To2953 is a sparse, linear scatter of basalt and obsidian artifacts along the northern margin of an ORB deltaic channel in the western portion of the delta. Materials are situated in and along the edge of an intermediate Yellow channel that contains some pea gravels. The channel is deflated slightly below the surrounding mudflats and most materials are along the northern edge of this deflated zone. The lithic assemblage at 42To2953 consists of 12 chipped stone tools and 22 pieces of debitage. The debitage includes nearly equal numbers of secondary and tertiary flakes and it appears that both core reduction and biface manufacture were undertaken. Basalt is the dominant material among both classes of artifacts, although obsidian also occurs. Core reduction flakes are the most common type of debitage; biface thinning flakes also occur although in lower numbers. Tools include eight Great Basin Stemmed points/point variants, including one specimen in two refitted pieces, three biface fragments, and one unifacially modified flake. An organic black mat deposit in the western portion of the site was sampled for plant identification and radiocarbon assay. Radiocarbon analysis of *Scirpus* sp. plant fragments recovered from the mat returned a date of 10,130 ± 80 B.P. (Beta – 221779). Although the result of this radiocarbon analysis dates organics deposited during the final stages of channel flow in the ORB delta, it also provides additional and important information regarding the timing of channel formations in the delta and, in turn, the earliest relative ages of associated archaeological sites, including 42To2953.

42To2954 consists of a small lithic scatter (about 20m in diameter) containing 10 flakes and seven tools situated just south of the intersection of two crossing channels. Because some materials are associated with the Yellow channel, and because there is a thin scatter of flakes and tools paralleling a relatively younger crosscutting distributary, the site may actually be associated with either channel. The debitage consists of seven basalt flakes (one core reduction and six tertiary) and three obsidian flakes (one core reduction and two biface thinning), and the tools include a basalt scraper, one biface fragment, a bifacially modified obsidian flake, and four Great Basin Stemmed points/variants.

Site 42To2955 is a diffuse lithic scatter surrounding a dense concentration of flakes and tools in the western Old River Bed (ORB) delta. Materials are atop a deflated mudflat surface adjacent a yet-unnamed (not color-coded) deltaic channel that somewhat parallels the Lavender channel but is unlikely to be related to it and is cross-cut by the Orange channel system. Approximately 80 lithic artifacts occur, many of which are in a ~5x5m cluster near site datum (see the 42To2955 IMACS plan map). Obsidian is the dominant material type along with various CCS (red, pink, and yellow/butterscotch) and some quartzite. The presence of CCS and quartzite materials is interesting, as they are rare in most ORB delta sites. The flaked obsidian includes both weathered and "fresh" pieces and it appears there are either two occupations of the site or materials have been differentially exposed. Reduction stages include some decortication flakes (detached from large cobbles) and abundant biface thinning debris. The latter are largely represented by flakes detached from late-stage bifaces, but includes a few thinning flakes from very large, early-stage bifaces. Tools (n = 9) include two cores, three unifacially modified flakes, one bifacially modified flake, one partially-finished undiagnostic (but likely stemmed) point, one biface, and a finely-made edge-ground unfluted concave-base lanceolate point. All tools are manufactured on obsidian. The presence of an unfluted concave-base projectile point at the site signals a Paleoarchaic occupation. The character of the point, as well as the assemblage as a whole, is markedly different than many of the other sites located in the ORB delta. Specifically, the craftsmanship of the lithic tools, in particular the concave-base point, suggests an early rather than later occupation during the Paleoarchaic, although this cannot be confirmed given the data at hand.

Site Evaluations

Each of the 13 sites reported here was evaluated for National Register of Historic Places (NRHP) eligibility using criteria outlined by the Department of the Interior. To be eligible for inclusion to the NRHP, these criteria state, among others, that a property must be important in American history, archaeology, or culture, and also possess "integrity of location, design, setting, materials, workmanship, feeling, and association..." (*National Register of Historic Places*, 36 CFR, part 60.4; see also National Park Service 1991). Moreover, each property must meet at least one of four criteria:

a) association with events that have made a significant contribution to the broad patterns of our history; b) association with the lives of persons significant in our past; c) embodiment of distinctive characteristics of type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant distinguishable entity whose individual components may lack individual distinction; or d) have yielded or may be likely to yield information important to history or prehistory (36 CFR 60.4).

Cultural resources, especially prehistoric sites, usually manifest a complex array of materials, behaviors, and taphonomic processes. As such, and because there are a number of ways to evaluate their significance (e.g., Glassow 1977), our site evaluations are based on both objective measures (e.g., observed artifact abundances, types, and diversity) and subjective inferences concerning the contents and integrity of the buried deposits they may (or may not) contain. The types and frequencies of surface artifacts are certainly consequential when assessing site significance and NRHP eligibility, but in most cases surface materials provide only a glimpse of site content and significance is based on more subjective evaluations regarding the extent and integrity of buried cultural deposits. This especially is the case in areas that have a long and complex geomorphic history - such as the ORB delta - and most of our evaluations are based on whether or not buried deposits are present, and whether or not these deposits are likely to contain information on prehistoric human behavior, datable materials, and/or paleoenvironmental data.

An additional consideration in our NRHP recommendations included observations on the "condition" of the artifacts on the surface of each site and whether or not the integrity of lithic materials and workmanship have been compromised. Specifically, and while we recognize the value of the Great Basin Paleoarchaic surface record (e.g., Beck and Jones 1997; Jones and Beck 1999), many ORB artifacts are so extensively patinated/weathered from thousands of years of exposure that manufacture characteristics (negative flake scars, platforms, etc.) have been obliterated. Analyses of these assemblages afford little (if any) technological information (C. Beck and T. Jones, personal communication, 2001), especially when they occur on deflated surfaces that contain no additional buried materials. As a result, our evaluations are largely based on Criterion d (36 CFR 60.4) or, more specifically, the potential to yield significant information beyond that gathered in field survey.

NRHP Eligible Sites

We recommend that seven of the 13 prehistoric sites (42To2945, 42To2947, 42To2948, 42To2949, 42To2951, 42To2953, and 42To2955) be considered eligible for nomination to the NRHP. Four of these sites were discovered on or directly associated with the Lavender channel, two are associated with the Yellow channel, and one (42To2955) is adjacent an obscure and yet-unnamed (no color) deltaic channel that somewhat parallels the Lavender channel but is unlikely to be related to it and is cross-cut by the Orange channel system.

Sites 42To2945 and 42To2947 are large lithic scatters containing more than 1,000 artifacts. Each contains large numbers of broken bifaces, flake tools, and Pinto points and Great Basin Stemmed point variants. Although 42To2945 is atop barren channel margins with no potential for buried deposits, it contains a large and diverse tool assemblage (including scrapers and a graver and drill) which strongly suggest that it served as a habitation site where a variety of tasks were performed. The types and frequencies of materials at 42To2647 suggest that it also witnessed prolonged occupation, and the presence of low dunes indicate that buried cultural-bearing deposits are present in some areas. Given their size, setting, content, and association, both sites offer the potential to yield additional artifact classes, including additional stemmed point variants, and useful information on Paleoarchaic lithic technological organization and adaptations. As such, we recommend that they be considered eligible for the NRHP under criterion d.

42To2948 and 42To2953 are also recommended as eligible for NRHP inclusion under criterion d. Both sites are scatters of flakes and tools containing numerous Great Basin Stemmed points/point variants. Although neither site has the potential for buried cultural deposits, each contains black mat deposits that provided radiocarbon age estimates marking the end of stream flow in the Lavender and Yellow channels. Organic remains directly associated with archaeological sites are rare in the ORB delta, especially in the deflated mudflats, and additional analyses of large samples of these deposits would undoubtedly provide useful information on terminal Pleistocene-Early Holocene biotic communities and climates.

42To2949 and 42To2951 are Paleoarchaic lithic scatters along channel margins. Each contains high tool-to-debitage ratios and the observed toolkits include a large number and variety of stemmed projectiles. Although both sites lack any potential for buried deposits, each contains differentially weathered lithic artifacts and analyses of the debitage may provide lithic technological information that is rare in most exposed sites on the deflated mudflats. Moreover, and even though 42To2951 has been impacted by relic collectors, we believe that both sites offer information on Paleoarchaic land use and adaptations beyond that gathered in survey recordation. As such, it is our opinion that sites 42To2949 and 42To2951 be considered eligible for inclusion to the NRHP under criterion d.

Site 42To2955 contains (and will yield additional) information on the regional Paleoarchaic Period and we recommend that it be considered eligible for the NRHP under criterion d. It is a scatter of lithic detritus and tools that include flake tools and a finely-made edge-ground unfluted concave-base lanceolate point. Like other exposed channel sites on the mudflats, 42To2955 does not have any potential for cultural-bearing deposits but there is great potential for extracting important technological data. First, it contains cores and quartzite and various CCS detritus, which are rare in ORB delta sites. Second, the site contains a dense cluster of lithic (especially obsidian) debris that may manifest a discrete reduction locus. Finally, many of the artifacts exhibit very little weathering and their recovery and analysis would provide a unique glimpse of Paleoarchaic lithic reduction strategies.

Non-Eligible Sites

We recommend that six sites be considered ineligible for inclusion on the NRHP. Sites 42To2943, 42To2944, and 42To2946 consist of diffuse basalt and obsidian scatters atop deflated segments of the Lavender channel. The limited diversity in artifact types, coupled with the fact that these sites contain no potential for buried deposits, argues that they are not likely to yield significant information beyond that which has already been recorded. Moreover, lithic artifacts at each site are extensively weathered/sand blasted and offer little, if any, technological information, all observed artifacts were characterized and mapped with a Trimble GPS unit, and diagnostic artifacts were collected for potential geochemical and hydration analyses. As such, we recommend that they be considered ineligible for the NRHP.

42To2950 is a small, linear scatter of ~20 weathered lithic artifacts on the deflated margins of the Lavender channel. It contains no intact deposits or diagnostic artifacts, all of the artifacts were characterized and plotted with a Trimble GPS unit, and the few remaining artifacts offer no technological information. As such, we are confident that 42To2950 contains no useful information beyond that gathered in survey recordation and recommend that it be considered ineligible for NRHP inclusion.

Site 42To2952 is recommended as not eligible for inclusion to the NRHP. It is a long, sparse scatter of approximately 60 lithic artifacts along the main Yellow channel and surrounding mudflats. All of the observed artifacts are atop a deflated surface where there is no potential for buried deposits. Moreover, most of the lithics are weathered/sand-blasted and offer little potential for extracting technological information. All artifacts were characterized and mapped in the field, diagnostic artifacts were collected and, save for seriation and/or geochemical analyses of the collected projectile points, we believe that the site contains no useful information on regional prehistory beyond that gathered in survey recordation.

Finally, site 42To2954 is a small scatter of 10 sand-blasted flakes and seven tools on a deflated mudflat surface. Because the scatter is associated with two separate channel distributaries, its exact context and association(s) remain unknown. All of the flakes and tools were mapped with a Trimble GPS unit and characterized and tallied in the field, and the basalt and obsidian stemmed points were collected for potential laboratory analyses. Save for conducting material sourcing/hydration studies on the collected artifacts, we are confident that survey recordation extracted all of the useful information that 42To2954 has to offer regarding Paleoarchaic settlement in the region. As such, we recommend that it be considered a non-significant property ineligible for NRHP inclusion.

Discussion

This project represents the fifth archaeological survey in the ORB delta and provides additional information on geomorphology and occupational chronology. As part of this survey we investigated a total of 633 acres in six parcels where we documented 13 archaeological sites. While the area is limited in terms of the overall size of the delta, this project in concert with the earlier surveys (e.g., Madsen et al. 2000, 2006; Schmitt 2002a) provides an additional inventory sample of the delta's major geomorphic features and common vegetational communities. Our focus for the current project was (1) to identify and characterize sites along more of the distributary channel systems on the southwestern margin of the ORB delta, and (2) to conduct a test of the possibility that buried late Paleoarchaic sites on the uneroded portion of the delta could be identified along channels evident in aerial photography. Results for the first aspect of the project are relatively unambiguous; those for the second aspect are much less so.

Archaeological reconnaissance in the mudflats along the Lavender and Yellow channels identified 13 sites. Sites associated with both channels range from relatively small and diffuse debitage scatters containing a few formal tools (e.g., 42To2944, 42To2950) to large and often dense scatters containing hundreds of lithic artifacts (e.g., 42To2945, 42To2947). Like previously recorded sites throughout the delta, most of the Lavender and Yellow channel sites have high tool-to-debitage ratios that reflect, at least in part, the extensive use of toolstone brought into the wetlands. One notable exception, however, is 42To2947 where more than 1000 pieces of basalt and obsidian debitage and a variety of tools point to one or more lengthy occupations where stone tool production was common.

Perhaps the most significant finds in our investigations were the discovery organic black mat deposits in two different ORB channels directly associated with archaeological sites. Radiocarbon assay of plant remains in the Lavender channel from 42To2948 returned a date of 9010 ± 40 B.P. and organics in the Yellow channel from 42To2953 were dated to 10,130 ± 80 B.P. These dates matched our estimates regarding the sequence of channel formation and the discovery of Pinto points/point variants on later Lavender channel sites likely date to the end of the ORB sequence ~8800 ^{14}C B.P. Although the results of radiocarbon analysis date organics deposited during the final stages of channel flow, they provide additional and important information on the timing of channel formations in the delta and, in turn, the earliest relative ages of associated archaeological sites. It is unlikely individual distributaries lasted more than 100-200 years, at most, and it is therefore likely that the age of associated sites is within the standard deviation of the dates on the channels.

We identified no sites along channels on the uneroded portion of the delta that we mapped from aerial photography and found only a single isolate, consisting of three nondiagnostic items, in our survey of these three parcels. There are a number of possible explanations for these results:

1) The channels we mapped from air photos may be spurious. Using vegetational differences may not be, and probably is not, the best way to identify sub-surface channels. Vegetational differences may be due to other factors. For example, part of the vegetational changes for the Orange channel we mapped on the uneroded fan may be the result of increased moisture at the toe of a small alluvial fan formed on the northeastern margin of Granite Peak. Use of ground penetrating radar (GPR) or other investigative tools may prove to be more reliable.

2) It may be that site density is limited and that Pinto-age sites already identified in the area are the only sites there. However, site density on the channels in the eroded mudflats is more than 1/km, and we would have expected to identify some 10 sites in the ca. 11 linear km of uneroded "channels" we surveyed. On the other hand, artifact density is limited on many of the Pinto-age sites that have so far been identified and it may be these sites were simply missed as a result.

3) It is possible the Pinto-age sites already identified have no direct relationship to channels that were flowing during formation of the ORB delta. They may have been associated with dunes now migrated away from their location, with vegetation associated with increased groundwater flowing along the more permeable sands of old channels (but post-dating the channels themselves), or they may have been occupied for reasons, as yet, unknown.

4) Finally, and most likely, it is simply difficult to identify sites in many areas of the uneroded under flow fan deposits. As Oviatt et al. (2003) note, the surface of the uneroded fan deposits has been planed off by sheet washing and other factors, obscuring any surface features which once may have existed. When combined with cryptogamic soils formed on the silts of the underflow fan, surface manifestations of older site may be difficult to discern. The few sites that have been identified on the uneroded fan occur in areas where "tiger stripes" are common. These are non-vegetated areas formed as wind erosion causes linear exposures of the basal silts to migrate along the route of prevailing winds. Darker-colored materials such as obsidian and basalt stand out against this unvegetated light-colored silt background, and it is in these areas where the very large majority of artifactual materials have been identified. Since "tiger stripes" were uncommon in the survey areas we selected, it is a distinct possibility that we simply could not see sites that were there.

In sum, our efforts to use aerial photography to identify ORB channels and associated buried Paleoarchaic sites in the uneroded underflow fan deposits of the delta were not successful.

However, there are a number of reasons why this was so, and we may need to rethink our tests of this hypothesis.

Management Recommendations

Based on results of 2006 fieldwork, we can reiterate our general management recommendations from previous years and include some new recommendations: sites along the ancient channels in the ORB delta are both numerous and extensive, and contain relatively rare and unusual Paleoarchaic components. Many of these exposed sites have been extensively disturbed by deflationary forces and, beyond their distribution, probable age, and the presence of a few diagnostic artifacts, they tell us little about how and why late Pleistocene-early Holocene foragers were living in the ORB delta. Although no early prehistoric sites were identified in our underflow fan surveys, Pinto-age sites have been reported (Page et al. 2003) and we believe that relatively pristine sites exist along buried sand channel margins in the flat delta plain, and partially deflated sites lie below the sand dunes at the interface between the plain and the mudflats. Moreover, and as the current project demonstrates, there are a number of significant Paleoarchaic sites along the network of channels in the southwestern portion of the delta, and in some areas there is potential for buried deposits. We recommend these sites be protected.

The identification of buried sites and site components may be prohibitively expensive, but there are a number of steps that can be taken to limit these costs. First, we recommend that the entire dune margin be inventoried to identify all of the exposed sand and intermediate channel sites. This survey can pay especial attention to dune edges where it may be possible to detect sites that are only partially exposed or are only beginning to be revealed by dune migration. This is not a large-scale project, as we have already covered much of the delta plain/mud flat interface during our previous surveys. These additional surveys can also cover the dunes themselves to identify all the Middle and Late Holocene sites they likely contain. Second, we recommend using a backhoe to investigate buried channels identified via air photos and digitally enhanced orthophoto quadrangles and further investigated by GPR within the delta plain. While it is not possible to explore all the channel margins below the surface, it should be possible to limit ground-disturbing activities to areas similar to those where previously recorded sites common along the exposed channels occur, such as the inner bend of migrating channels. Third, we recommend examination of unsurveyed segments of the prominent gravel channels (see Figure 1; Black channels) west and north of Lake Öferneet (Schmitt et al. 2003) and a sample of neighboring mud flat parcels to more fully investigate the context and character of Paleoarchaic materials in these areas.

Fourth, we recommend that the margins of the Lake Öferneet playa be intensively surveyed. Although our visits have been brief and only two sites have been fully mapped and recorded, we strongly suspect that areas surrounding Lake Öferneet contain some significant and pristine Paleoarchaic sites. Lake Öferneet is bounded by massive ORB gravel channels which are covered in many areas by a veneer of Holocene aeolian sediments. Given this unique setting it is probable that a number of sites surround Lake Öferneet, context suggests that most will date to the early Paleoarchaic period, and the probability of encountering habitation sites adjacent this ancient wetland habitat is high. Thus far, our limited surveys encountered Paleoarchaic sites, isolated crescents, and, most importantly, we observed partially buried artifacts at Öferneet Falls (42To1370) which indicate that buried cultural deposits occur in some areas. If datable materials and/or subsistence residues occur in any of these Paleoarchaic sites, the archaeological significance of such an association(s) for Great Basin prehistory would be profound (e.g., Beck and Jones 1997; Elston and Zeanah 2002). We believe that the gravel channel margins surrounding Lake Öferneet and vicinity should be intensively surveyed and, where pertinent, we recommend that limited test excavations be conducted to assess the content and integrity of subsurface deposits. Until these tasks are complete, we recommend that no military training exercises or other potentially adverse undertakings be performed in this area.

Finally, we recommend using the toolstone from the many Paleoarchaic sites exposed in the ORB delta to more fully understand the forager mobility and chronology associated with the sites. Most of the toolstone on these sites is fine-grained basalt whose sources have, for the most part, been recently identified (Duke and Young 2007; Page 2006). Spatial analysis, coupled with additional geochemical sourcing of artifacts will enable us to learn more about how these foragers moved about the landscape. Some steps have been made in that direction (e.g., Page 2006), but much remains unknown. Additional sourcing of obsidian artifacts would complement completed work towards understanding basalt use in the delta. Further efforts should be employed to determine the ages of sites in the delta, especially the southwest channels. Additional radiometric dating of plant remains in organic black mats deposits, where encountered and the use of obsidian hydration should also be used to determine at least the relative age of the sites.

Absent these approaches, we recommend that subsurface disturbance of the ORB delta be avoided wherever possible, and, where it cannot, that mitigative measures be implemented on known sites and suitable monitoring programs be developed to identify subsurface sites that may be encountered. The Paleoarchaic/Early Archaic sites in the ORB delta are unique and highly significant in terms of criteria defined under the Historic Preservation act. They deserve to be protected.

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APPENDIX A

Site Forms

APPENDIX B

Isolated Artifact Forms