New light on the prehistoric Purrón Dam Complex: Small corporate group collaboration in the Tehuacán Valley, Puebla, México

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The 2003 and 2004 surveys at the Purrón Dam Complex (PDC) demonstrate the value of resurveying previously studied areas. Additional habitation sites, water management features, a cave with pictographs, and a major canal were discovered, increasing the number of recorded sites from eight to 57. From this survey, the collected ceramics and a synthesis of 12 chronometric dates suggest that water management was initiated in the complex by Early Formative times at ca. 1050–1100 B.C., and that the Purrón Dam was completed by the Middle Formative Period (ca. 650–450 B.C.), when settlements were small and decentralized. This challenges previous interpretations that place the PDC florescence during the Early Classic Period (ca. 150 B.C.–A.D.250), a period with larger aggregated communities displaying social ranking. The results of our survey have implications for understanding the links between political complexity and agricultural intensification, and support recent ethnographic and archaeological research discrediting the argument that increasing social complexity necessarily leads to the construction of large water management systems.

Keywords: Mesoamerica, Formative Period, water management, pedestrian survey, corporate groups

Introduction

Newly discovered sites and direct chronometric dating of features at the Purrón Dam Complex (PDC), demonstrate the value of reinvestigating previously studied areas, and provides evidence that supports the decoupling of the de facto linkages often made between social complexity and sophisticated water management systems. The PDC is located in the Barranca Lencho Diego, a ravine with intermittent drainage in the southern portion of the arid Tehuacán Valley (FIG. 1). The PDC consists of habitation sites, a cave with petroglyphs, prehistoric agricultural fields, and water management features—including the massive Purrón Dam (FIG. 2) which, in its final form is the largest prehistoric water management structure yet found in Mesoamerica having a total earth and stone volume of approximately 390,000 cu m.

The PDC was first reported in Woodbury and Neely's (1972) study of water management as part of the Tehuacán Archaeological-Botanical Project (MacNeish 1967-1972). Their investigations (Woodbury and Neely 1972: 81, 83) indicated that the initial construction of the dam began at approximately 750 B.C. during the Middle Formative Period, followed by a near total abandonment during the Classic Period, and subsequent reoccupation during the Postclassic Period (FIG. 3). Their study also provided estimates of local population numbers, the manpower required for construction, and the dam's reservoir capacity. The only other substantive fieldwork at the complex was conducted by Charles Spencer (1979) who revisited the sites identified by Woodbury and Neely, but did not record any new sites. From his investigations of the previously recorded sites, Spencer concluded that settlement pattern chronologies in relation to water management features indicated a regional social complexity that developed out of aggrandized control over irrigation systems that were used to produce special tropical cultigens, which were traded as prestige goods for extra-local materials (Spencer 1979).

The findings of these two studies have been incorporated into models of prehistoric cultural development in Mesoamerica as well as theories of social complexity and agricultural intensification for over 40 years (Carballo *et al.* 2014; Manzanilla 1994; Parsons 1974; Patterson 1990; Scarborough 2006; Spencer 1979, 2000). The Purrón Dam is frequently mentioned in regional cultural histories (Adams 2005; Evans 2004; Spencer and Redmond 2000);

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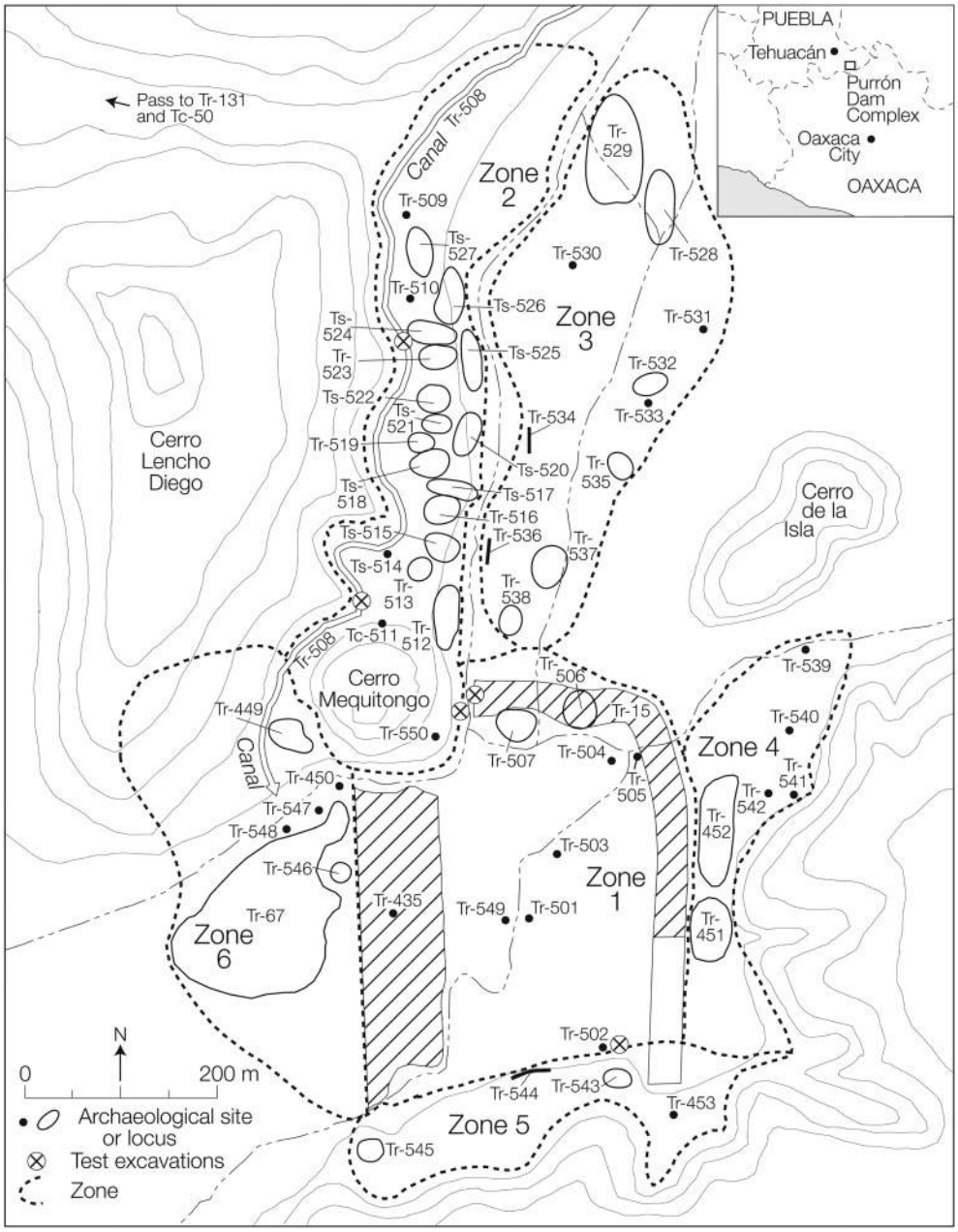

Figure 1 Map showing the Purrón Dam Complex. The survey's geographic sub-areas (1–6) are delineated. Also shown are the ancient canal, test excavation locations, and sites discovered (e.g., Tr-549). The contour interval is approximately 20 meters.

studies of prehistoric agricultural technology in Mesoamerica (Doolittle 1990, 2004; Hunt 1994; Marcus 2006; Neely in press; Scarborough 2003; Scarborough *et al.* 2012; Smith 1985); global histories of hydraulic engineering (Lawton and Wilke 1979; Schnitter 1994); and as an example of a sustainable agricultural technology (Bruins *et al.* 1986; Ore and Bruins 2012).

As part of the valley-wide investigations initiated by Neely (2001; Neely and Castellón Huerta 2003, 2014), the PDC was revisited. Pilot field trips and work by local engineers and development workers (R. Hernández Garciadiego, personal communication 2003) discovered new archaeological sites and water management features. New investigations were conducted to fill many of the "gaps" that Woodbury and Neely recognized in their previous survey and to evaluate the relationship between water management and social complexity at the PDC in light of new theory and new data. The goal of this study was to assess how the discovery of new sites, a better understanding of the hydrological context, and a refined chronology of the PDC challenge its existing interpretations. More specifically, this study sought to evaluate where the PDC fell within recent theoretical debates about the relationship between socioeconomic complexity and large water management systems, whether they be studies Butzer (1996) characterized as "Neo-Wittfogelian" that continue to identify examples of emerging social complexity with water management

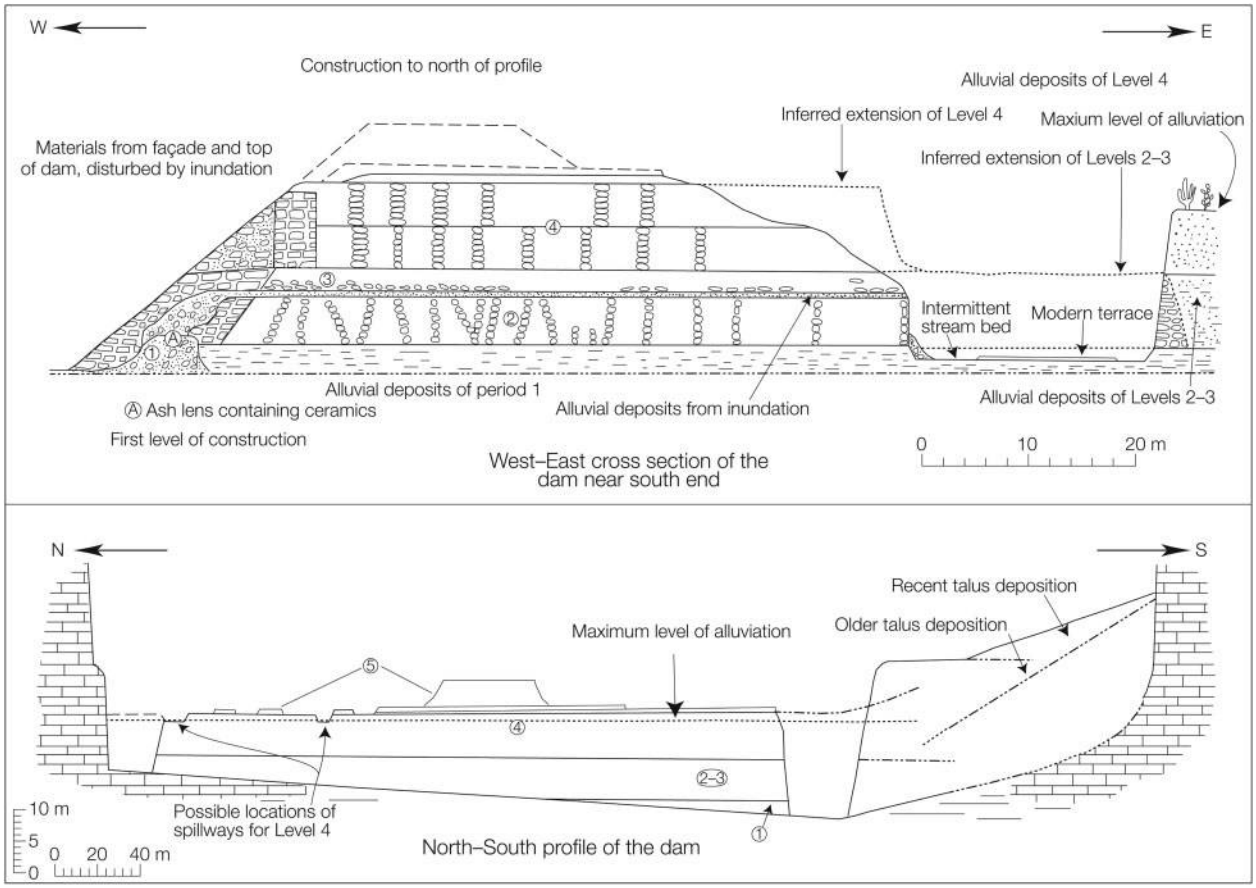

Figure 2 Transverse (top) and longitudinal (bottom) sections of the Purrón Dam. Adapted from Woodbury and Neely 1972: fig. 8.

Calendrical years	*Mesoamerican archaeological period (Evans 2004)*	*Tehuacán Valley archaeological phase (MacNeish 2001)*
	Historical	
	Postclassic	Venta Salada
1000 A.D.	Classic	Palo Blanco
1 A.D./B.C.	Middle–Late Formative	Santa Maria
1000 B.C.	Early–Middle Formative	Ajalpan
2000 B.C.	Transition, Late Archaic to Formative	Purrón

Figure 3 Chronological table for Mesoamerica and the Tehuacán Valley.

(e.g. Davies 2009; Harrower 2009; Manzanilla 1994); those largely based on ethnographic research that argue complex water management systems do not necessarily drive emerging social complexity (Erickson 2006; Hunt 1988; Hunt *et al.* 2005); or more nuanced interpretations of heterarchical relationships between water management and society (Scarborough and Clark 2007).

Hydrology and Climate

The Tehuacán Valley is bordered on the east by the Sierra Madre de Oaxaca, known locally as the Sierra de Zongólica, and on the west and south by the Sierra de Zapotitlán, which is part of the Sierras Mixtecas. The Rio Salado drains the valley from north to south. The Sierra de Zongólica intercepts much of the moisture coming from trade winds in the Gulf of Mexico (Byers 1967; Enge and Whiteford 1989) leaving the Tehuacán Valley in a rain shadow. Except for the high elevations of the piedmont, some form of irrigation is required to support all but an unpredictable seasonal agriculture within the valley, and is an absolute necessity for more exotic plants (Smith 1967: 233, 240, 242) and for agricultural intensification. Mean annual precipitation varies today from 250–500 mm, with a rainy season from June through September. While the structural controls bounding the valley tempered large-scale shifts in climate over the length of time that the PDC was used (Smith 1967: 240, 242), relatively minor climate fluctuations coupled with local anthropogenic

manipulations could have impacted local ecology and stream hydrology. The geological and hydrological observations of Brunet (1967), now supported by archaeological and historical data, point to a steadily lowering of the water table within the valley over the centuries of its occupation.

The Barranca Lencho Diego comprises a double-branched intermittent watercourse in a ravine which lies in one of the warmer parts of the Tehuacán Valley, with a temperature range of about 4° to 45° centigrade and a mean annual temperature of about 25° C. Its catchment basin includes a piedmont formed by portions of the Cerro Chichiltepec; foothills formed by a succession of Cretaceous and Cenozoic conglomerates, gypsum, siltstone, and limestone; an alluvial valley having terraces; as well as alluvial fans and down-cut *arroyos* (intermittent creeks) that debouche into the Río Salado. The Purrón Dam lies near the mouth of the Barranca Lencho Diego at an elevation of about 920 m, and has a catchment area of about 30.5 sq km. It is situated at a 400-m wide constriction in the alluvial valley formed by outcropping foothills. Upstream from the dam are alluvial fans, while downstream from the dam portions of the relatively level floodplain are being irrigated at present or were formerly farmed, as evidenced by ridged fields overgrown with scrub vegetation.

Methods

Our investigations consisted of pedestrian survey, geoarchaeological investigations, and limited test excavations of water management features. Localities described in the original site report as well as newly identified sites were recorded with the aid of aerial photographs and GPS recordation. To facilitate our restudy we divided the barranca into six geographic sub-areas: (1) the dam and reservoir area, (2) the western periphery, (3) the floor of the ravine upstream from Tr-15, (4) the eastern periphery, (5) the southern periphery and (6) the barranca floor of the ravine downstream from the Purrón Dam (FIG. 1). Our survey of the PDC covered an area measuring about 600 m east-west by 800 m north-south (about 480,000 sq m). A transit was used to establish elevation relationships between water management features, natural landforms of the barranca, and adjoining terraces and slopes. Determining surface elevations, establishing the slope of the ravine by topographic mapping, and geoarchaeological observations of sedimentary sequences in arroyo cuts allowed us to more precisely document the relationship between the hydrological setting and water management features. Limited test excavations were restricted to non-habitation site locations associated with a canal and the faces of water management features along arroyos to view architectural elements and collect charcoal and sediments for dating. To refine the chronology we compiled existing radiometric dates and conducted new dating, which included radiocarbon dating and single-grained Optically Stimulated Luminescence (OSL) dating of sediments reported in part by Aiuvalasit and colleagues (2010) but fully synthesized with the cultural chronologies of occupation herein (TABLE 1).

Newly discovered sites were designated like those found previously (MacNeish 1967: 27): they were given a prefix indicating the general nature of the site (i.e., "Tc" denoting a cave or rockshelter, "Tr" indicating a site with visible architectural remains, and "Ts" designating a site with no visible architectural remains) and a number continuing the sequence of sites registered by the Tehuacán Project. As the number "500" was the last site number assigned by MacNeish and colleagues (1972: 522–527), we continued the site numbering with "501." Representative collections of ceramic sherds were studied from loci considered to be crucial in determining the temporal boundaries of the habitation sites and water management features, or found during the stratigraphic tests. The collections were small, and currently remain in Mexico in the care of R. Hernández Garciadiego in Tehuacán and P. Miranda Pacheco in Zapotitlan Salinas.

Results of the New Survey

Our intensive survey expanded the total number of sites comprising the complex from the eight identified in 1964 (Woodbury and Neely 1972: fig. 9) to 57, as summarized in the online supplement (http://www.maneyonline.com/doi/suppl/10.1179/2042458215Y.0000000010). Within the discussion of each sub-area of the survey, our investigation results are placed in direct comparison to the previous investigations to demonstrate the utility of the new survey and to show the significance of the findings to our interpretations of the PDC.

Sub-area 1: The dam and reservoir area

Nine sites were recorded in the dam and reservoir area, two of which (Tr-15 and Tr-435) were restudies of features recorded in 1964 (FIG. 1). The following discussion proceeds chronologically relative to the site being considered.

TR-15 (THE "COFFERDAM")

Tr-15 is a large arcuate stone and earthen structure that spans the ravine upstream from the Purrón Dam (FIG. 1). It is approximately 550 m long, 30 m wide, and ranges from 3–5 m high. The base of Tr-15 is at a higher elevation than the maximum height of the Purrón Dam, therefore it was never within the reservoir of the Dam. Tr-15 impounded its own sediments as observed in arroyo cuts upstream from its construction (FIG. 4). Based on diagnostic ceramics found embedded in its construction and in

Table 1 Radiometric dates from the Purrón Dam Complex

Laboratory and Sample Number	Dating Method	Sample Context	$\delta^{13}C$	Uncalibrated age (yr B.P.)	Calibrated age range (B.C./A.D.) at 1-σ / 2-σ (14-C and AMS) and 1-σ (OSL)	Reference
Purrón Dam (architecture)						
DIC-2030	14-C	Purrón Dam, between Levels 1-2		2170 ± 100 BP	*364–147 B.C.*/403 B.C.– A.D 26	Drennan, personal communication
Purrón Dam (impoundment)						
Shfd06132	OSL	Sediments from 45 cm below the top of the reservoir profile		0.78 ± 100	A.D 1327–1127	Aiuvalasit *et al.* 2010
				0.95 ± 120	A.D 1177–937	
Shfd06131	OSL	Sediments from 440 cm below the top of reservoir profile, collected at the base of fine grained sedimentation above Phase 3 gravels		2.78 ± 170	613–943 B.C.	Aiuvalasit *et al.* 2010
Santa Maria Canal						
Beta-233267	AMS	Charcoal in Canal fill, 100 cm below surface		1370 ± 40 BP	*A.D. 632–681*/A.D. 599–712	Aiuvalasit *et al.* 2010
Beta-233268	14-C	Charcoal in Canal fill, 190 cm below surface		1790 ± 40 BP	*A.D. 208–258*/A.D. 127–345	Aiuvalasit *et al.* 2010
Shfd06130	OSL	Sediment in Canal fill 192 cm below surface		2.26 ± 400	653 B.C.–A.D. 147	Aiuvalasit *et al.* 2010
TR 15 ("Coffer Dam")						
SI-124	14-C	Base of sluice		2750 ± 60 B.P.	*937–828 B.C.*/1028–802 B.C.	Woodbury and Neely 1972: 93-94
Beta-233269	AMS	Charcoal from just above transition from gypsum to sandstone blocks, east test pit, Tr-15	−23.5	3950 ± 40 BP	*2494–2437 B.C.*/2503–2336 B.C.	*This report*
Beta-233270	AMS	Charcoal from mortar at base of sandstone wall of sluice, west test pit, Tr-15	−22.8	2860 ± 40 BP	*1060–975 B.C.* /1131–913 B.C.	*This report*
Beta-233271	AMS	Charcoal from mortar in sandstone wall of sluice, west test pit, Tr-15	−23.2	2890 ± 40 BP	*1129–1005 B.C.* /1212–972 B.C.	*This report*
Purrón Cave						
I-568	14-C	Zone H - stratigraphic horizon with first appearance of cultigens		2220 ± 150 B.P.	*413–41 B.C.* /598 B.C.–A.D. 66	Johnson and MacNeish 1972: 23
I-575	14-C			2590 ± 150 B.P.	*899*–516 *B.C.*/1090–384 B.C.	Johnson and MacNeish 1972: 23

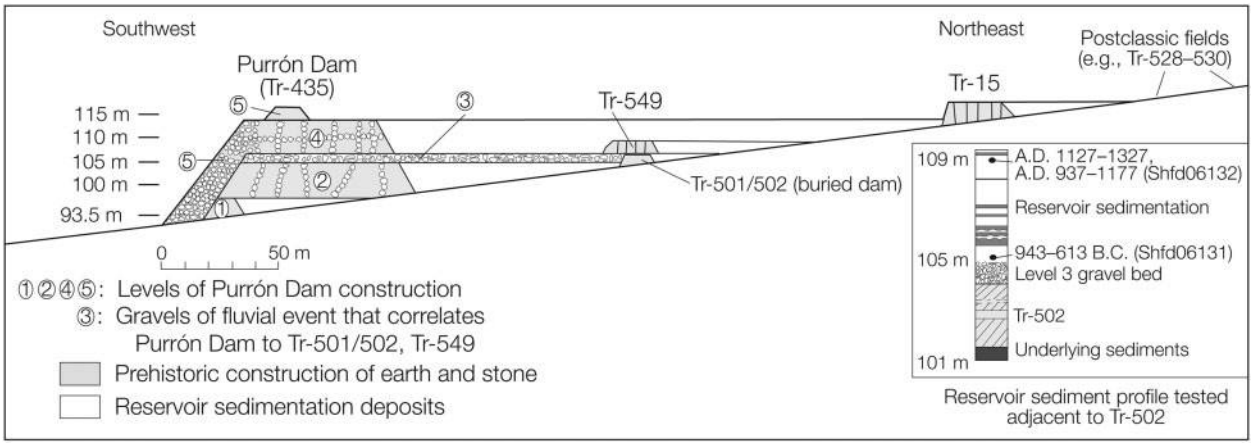

Figure 4 Schematic cross-section drawing of the Purrón Dam with the other dams located upstream (see TABLE 1).

a test pit excavated immediately west of Tr-15, Woodbury and Neely (1972: 90–96) interpreted Tr-15 as being roughly contemporaneous with the Level 2 Purrón Dam construction during the Early/Middle Santa Maria Phase (ca. 600 B.C.), and that it functioned as a *cofferdam* (a structure constructed around the upper perimeter of the Purrón Dam's reservoir to hold back water and thereby facilitate repairs and rebuildings of the dam). Three newly identified habitation sites, Tr-504, Tr-506, and Tr-507, which based on ceramic assemblages date primarily to the Postclassic but may also have Middle to Late Formative components, were found atop or adjacent to Tr-15 (FIG. 1, online supplement [http://www.maneyonline.com/doi/suppl/10.1179/2042458215Y.0000000010]).

Two test pits were excavated through colluvium and localized alluvium to expose a cross-section of Tr-15 in the west branch of the Barranca Lencho Diego. One pit was placed so that the its eastern wall was formed by the Tr-15 construction (FIG. 1). This pit was directly east of, and about 15 m across the ravine from, the "western sluice" (a small canal channel used to direct the flow of water) reported by Woodbury and Neely (1972: 88–89, figs. 11–13). The second pit was placed so that the western sluice formed the western edge of the pit. Excavations identified an incremental change in the construction materials from the use of slab-like, tannish-white gypsum stone in the earliest (lower) levels to block-like, reddish-brown sandstone and siltstone in the later (upper) levels. This change of construction materials was observed in other arroyo cuts through Tr-15 (Woodbury and Neely 1972: fig. 11), as well as between Level 2 and Level 4 of the Purrón Dam and between Tr-501/502 and site Tr-549 (discussed below). Three Accelerator Mass Spectrometry (AMS) samples were collected from these test pits, one from the eastern pit and two from the western pit (TABLE 1). The resulting dates, from early to late, were: 3950 ± 40 B.P. (Beta Analytic #233269) = ca. 2420 B.C. (2503 to 2336 CAL. B.C.), from charcoal recovered from just above the transition from the gypsum to the sandstone in the eastern pit; 2890 ± 40 B.P. (Beta Analytic # 233271) = ca. 1092 B.C. (1212 to 972 CAL. B.C.), from charcoal found in the mortar of the sandstone wall of the sluice in the western pit; and 2860 ± 40 B.P. (Beta Analytic # 233270) = ca. 1022 B.C. (1131 to 913 CAL. B.C.), from charcoal found in the mortar at the base of the sandstone wall of the sluice in the western pit. While the dates from the western pit indicate Tr-15 was constructed in the Ajalpan Phase of the Early Formative Period, the very early date of 3950 ± 40 B.P.or ca. 2420 B.C. (at 2σ), recovered from the stratigraphically lowest level exposed in the eastern pit, currently remains unexplained. If this date is accurate, it suggests a much earlier initial construction of Tr-15, as early as the Abejas or Purrón Phase of the Archaic Period (FIG. 3). The only sites in the ravine with an Ajalpan occupation are Purron Cave (Tc-272) and Abejas Cave (Tc-307), located about one kilometer north of the PDC. However, the largely buried sites Tr-538 and Tr-550 may have an Ajalpan Phase component, and would fit into the "Waterway Hamlet" settlement type (MacNeish *et al.* 1972: 359).

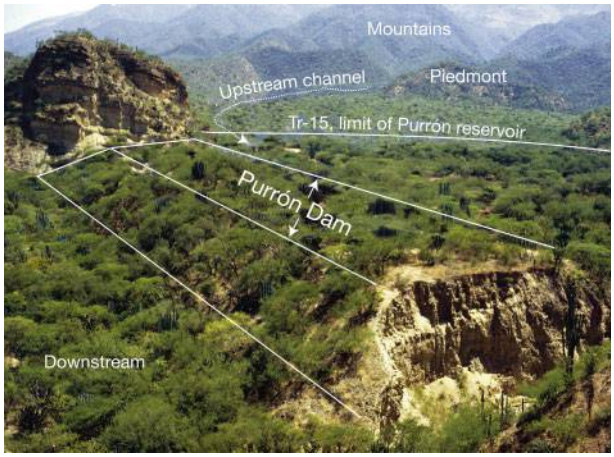

Figure 5 The Purrón Dam, looking northeast. The north end of the dam abutted the Cerro Mequitongo (upper left) and the profile of the south end of the dam exposed by arroyo cutting is visible at the lower right. Adapted from Aiuvalasit *et al.* 2010: FIG. 2.

It is not yet known when the entire arc of Tr-15 was constructed, but similarities in construction techniques observed in arroyo cuts suggest that it spanned a sizable portion of the ravine from early in its history. If the lowest level of Tr-15 were a continuous construction this would precede the complete damming of the ravine by the Purrón Dam by several hundred years.

TR-435 (THE PURRÓN DAM)

Arroyos created north and south profiles of the Purrón Dam (FIGS.1, 2, 5). Our reinvestigation included rappelling down the exposed southern profile to closely note each level's construction techniques and to take elevation measurements to facilitate correlations to upstream construction and sedimentation sequences. Measurements of the profile exposure and the dam itself confirmed the original identification of a five level sequence of construction (with Level 1 being the earliest), which in total consists of a dam construction sequence about 21-m high, capped by a 5-m high Postclassic pyramid (FIG. 2). Measuring along the southern profile, the dam is 106 m west to east, and it completely spans the ravine's 400 m width. The dam's Level 1 consists of a 2.8 (H) × 6 (W) m construction of fine silts and gravels faced with unmodified cobbles and small boulders. Measurements of slope show that this earliest dam would not have spanned the entire width of the ravine, confirming topographic relationships noted by Woodbury and Neely (1972: 84). Stratified layers of coarse gravels are found in profile behind Level 1, indicating this level of the dam impounded sediments from flashfloods. The ceramic assemblage recovered from Level 1 during the initial survey dated it to the Middle Formative, however, unreported charcoal collected by R. Drennan (personal communication 2002) in 1979, from an ashy feature in the dam's south profile found between construction Levels 1 and 2, dates it to 403 B.C.–A.D. 26 (at 2σ) (DIC-2030), which covers a wide time range from the Middle Formative into the Late Formative (TABLE 1).

Our elevation measurements show the 8 (H) × 75 (W) m Level 2 construction was the first to completely span the ravine, verifying earlier findings (Woodbury and Neely 1972: 86). The internal cellular construction, consisting of vertical walls made of stacked, large, well-rounded metamorphic cobbles and filled with well-rounded alluvial pebbles in a silt loam matrix, is analogous to the construction seen in the newly discovered dam Tr-501/Tr-502 found upstream (discussed below).

Level 2 is overlaid by Level 3, a complex amalgam of 30–60 cm of bedded fluvial gravels and sand capped by an intermittently-present 10 cm lime plaster layer and a 60–100 cm thick layer of alternating bands of gravel fill. Layers 2 and 3 are separated by an unconformity, or erosional surface. While this was observed in the original survey (Woodbury and Neely 1972: 87), what was not observed was that the fluvial gravels serve as a traceable stratigraphic marker in the reservoir deposits impounded up to 200 m upstream from the dam (FIG. 4). Therefore, as these fluvial deposits can be correlated with the reservoir sediments, the Level 3 fluvial events serve as a chronostratigraphic boundary between earlier phases of dam construction and sedimentation below and later phases above. An OSL dating sample was taken from impounded sediments immediately above the Level 3 fluvial gravels found atop a newly discovered dam (Tr-501/Tr-502). This sample provides a bounding chronology for the first three levels of the Purrón dam construction at 943–613 CAL B.C. (at 1σ) (Shfd06131) (FIG. 4; TABLE 1) which more closely aligns with the ceramic chronology for the Early Santa María Phase (Middle Formative Period) origins than does Drennan's radiocarbon date.

Level 4 is the most massive and complex construction level of the dam. It is 9 m high and 75 m wide, spans the entire ravine, and is visible in both the northern and southern arroyo cuts of the dam. Construction employed two techniques: internal cellular walls and a downstream curtain wall (a non-structural outer wall), using both unshaped fluvial rocks and shaped tabular gypsum slabs and blocks of red sandstone and siltstone blocks from adjacent outcrops. Level 4 has horizontal cross walls at the top, center, and bottom of the construction, while the curtain wall of tabular gypsum blocks armored the entire downstream face of the dam. While future dating will be required to secure the initial findings, the OSL dates from fine-grained sediments immediately above the Level 3 fluvial gravels could only have accumulated in the low-energy depositional contexts (i.e., the reservoir) behind the Purrón Dam after Level 4 was built. This strongly suggests that the maximum extent of the dam (as well as its maximum potential reservoir volume of about 979,740 cu m) was constructed during the Middle Santa Maria Phase of the Middle Formative Period.

Level 5 consists of two parts. The first is a 1 to 1.5-m thick deposit of gravels atop the Level 4 curtain wall and the internal cellular construction. The deposit becomes finer from well- to sub-rounded metamorphic cobbles at the base to well-rounded small pebbles with some evidence of imbrication at the top. It is capped by an abrupt, and possibly culturally derived, 4-cm thick clay siltstone lens. The upwardly fining sequence suggests that the first, lower part, of Level 5 is a flood deposit, representing a dramatic fluvial event to overlay Level 4 construction. OSL samples

from the top of the sedimentation sequence behind the dam (FIG. 4; TABLE 1) date to A.D. 1127–1327 and A.D. 937–1177 (calibrated at 1σ), which correlate to the Postclassic Period. The second part of the Level 5 construction, using the Level 4 flooding event deposit and possibly constructed siltstone lens as a foundation, involves a large 5-m high pyramid as well as several platforms and small mounds (Woodbury and Neely 1972: fig. 9). This complex may have functioned as the politico-ceremonial center for the Postclassic occupants of the ravine. The many Venta Salada Phase (Postclassic) sherds found on these structures represent an occupation continuum from ca. A.D. 1100 to 1500 (Woodbury and Neely 1972: 94). Excavations of the structures atop the dam, and at Tr-453 (discussed below), are needed to clarify the Postclassic occupation of the ravine.

TR-501/TR-502 (BURIED DAM) AND TR-549 (BURIED STRUCTURE ABOVE TR-501)

Segments of a new dam (Tr-501/Tr-502) were found exposed in two arroyo cuts in the eastern branch of the ravine about half way between the Purrón Dam and Tr-15 (FIG. 1). These segments, approximately 100 m apart and having similar construction and elevation, align to form a long earth and stone dam buried by about 5 m of alluvium. This dam's construction consisted of vertical retaining walls, 2.5 m high single courses of dry-laid river cobbles and small boulders, that form cells filled with angular pebbles and channel gravels of gray siltstone, similar to Level 2 of the Purrón Dam. Gravel deposits, 30–75 cm thick, which correlate with the Level 3 fluvial deposits of the Purrón Dam, cap this dam (FIG. 4). Above the gravel deposits are 4.5 m of alternating red and gray silty clay to silty loam deposits from flooding events originating from different segments of the catchment area.

This dam significantly changes our understanding of water management within the PDC. No ceramics were recovered, but the OSL sample collected from the reservoir profile immediately above the Level 3 fluvial marker horizon (see above) indicates Tr-501/Tr-502 is at least as early as the Middle Santa María Phase. However, the similarity of construction to Level 2, suggests that it also dates to the Early Santa María Phase. Thus, during the early part of the Middle Formative Period the PDC included a series of dams across the ravine floor, consisting of Purrón Dam Levels 1 and 2, Tr-501/Tr-502, and Tr-15. Each dam would have formed a small reservoir, which in the case of Tr-501/Tr-502 would have extended ca. 45 m upstream from the feature.

Tr-549 is an isolated stone wall or platform cross-section found in the profile just west of the exposure where Tr-501 was identified (FIG. 1). The feature is 1.7 m high, 14 m wide, and is capped by 2.5 m of silts within the Purrón Dam reservoir. No associated ceramics or occupation surfaces were identified. While Tr-549 was not found directly above Tr-501, it is situated stratigraphically above gravels associated with the Level 3 fluvial events (FIG. 4). Therefore, Tr-549 post-dates Tr-501/Tr-502 and Levels 1–3 of the Purrón Dam. Architecturally, Tr-549 is significant because it is constructed of dry-laid, shaped slabs of tabular gypsum and blocks of red sandstone and siltstone similar to Level 4 of the Purrón Dam and the upper construction levels of Tr-15.

TR-503, TR-505, TR-539 (ADDITIONAL SMALL DAMS)

Three other small dams buried in alluvium were observed in arroyo cuts in the reservoir. Their positions precluded making correlations to other construction features, and no diagnostic artifacts were recovered. Tr-503 is located between Tr-501/Tr-502 and Tr-15 (FIG. 1), and consists of a rock wall of about 10 courses of dry-laid angular gypsum blocks. It is 1.4 m high, 3.4 m wide, and has impounded coarse gravels on its upstream side like those of Level 1 of the Purrón Dam. Tr-505 is located near Tr-15 and is buried by 120 cm of alluvium. It is 50 cm high, and hangs 50 cm above the eroded bottom surface of the arroyo. It is 5.3 m wide and is constructed of slabs and a few blocks of gypsum. Tr-539 is a 1 × 2 m unmodified gypsum rock dam cross-section that could not be dated; it is upstream from Tr-15.

Sub-area 2: The western periphery of the Barranca Lencho Diego

Upstream from Tr-15, the western periphery of the Barranca Lencho Diego has a series of step-like terraces (FIG. 6). Alluvial terraces 1–2 m high flank the ravine bottom while higher colluvial terraces are present 4 to 10 m above the ravine floor along the eastern margins of Cerro Lencho Diego (FIG. 1). Some of these surfaces were modified to create level surfaces for habitations and agriculture. We recorded 21 new sites representing a far more significant occupation of the Barranca Lencho Diego than previously realized. A small cave site with petroglyphs, an irrigation canal, habitation sites, artifact scatters, and leveled agricultural field surfaces were identified.

TC-511 (CUEVA SANTIAGO)

This site is probably the small cave described as a: "... colonial period gypsum mine." recorded in 1961 (MacNeish and García Cook 1972: 67). It is located near the center of the north face of the Cerro Mequitongo (FIG. 1), a knob-like landform used as the buttress against which the northern end of the Purrón Dam was constructed.

This feature may be more appropriately called a "cavate" (Powell 1886), as it is evident that humans

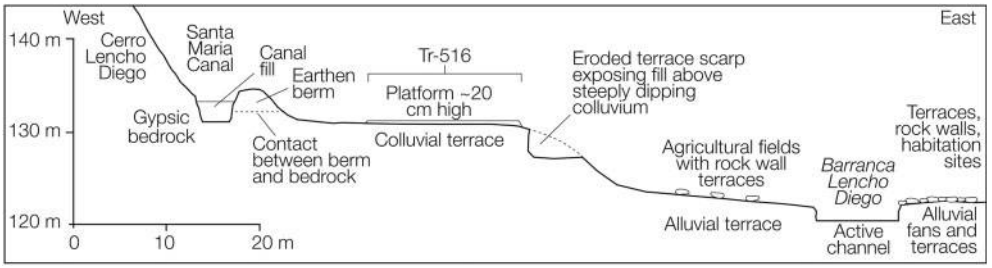

Figure 6 Schematic west to east cross-section of the Western Periphery geographic sub-area (#2) of the Purrón Dam Complex.

cut the walls and ceiling of gypsum into roughly level planes. That it was used for ceremonial or ritual activities is supported by the presence of numerous petroglyphs found incised and pecked into the irregular surface of the north, east, and west walls (FIGS.7, 8), the presence of Coxcatlan Course pottery (MacNeish *et al.* 1970: 212–217), and a human-constructed level area in front of the cave's mouth similar to those terrace-like platforms constructed in front of human-made caves in central Mexico found by Tucker, Medina Jaen, and Brady (personal communication 2005).

The petroglyphs found on the rough, porous, but sometimes plastered, walls probably belong to different cultural periods because of varied styles of presentation and overlap. Geometrics (lines, circles, rhomboids), anthropomorphs (stick figures, hunters armed with spear-throwers), and zoomorphs (quadrupeds, lizards, snakes, and a turtle) constitute the assemblage. The origin of these petroglyphs can be tentatively placed in the Ajalpan Phase of the Early Formative Period, with evidence of subsequent additions (Rincón Mautner 2005; personal communication 2004). Two H-shaped elements (FIG. 8) may be related to the incised design (a possible "ballcourt" glyph?) seen on the limbs of some solid, polished, white, anthropomorphic figurines found in the Early Santa María Phase (MacNeish *et al.* 1970: 97). Based on the petroglyphs, ceramics, and its terrace-like platform/porch, this site was possibly used as early as the Late Ajalpan, probably used in the Early Santa María Phase, but is securely dated to the Middle and Late Santa María Phases as well as the Early and Middle Venta Salada Phases (FIG. 3). That such a site exists as part of a complex of sites and water management features presents an opportunity to make richer interpretations of the linkages between symbolism, social organization, and ceremonialism/religion (Shaw 2007).

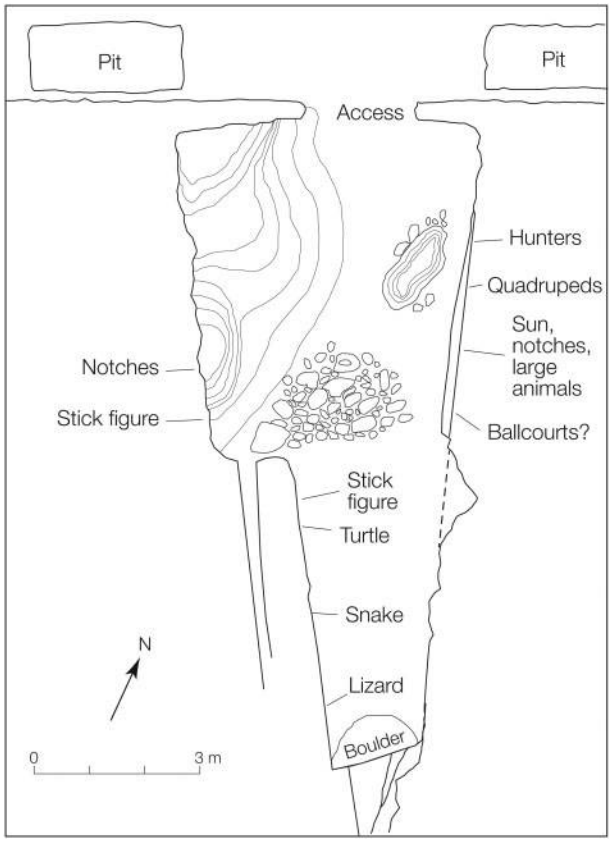

Figure 7 Plan view of Cueva Santiago, showing the relative locations of some of the petroglyphs. Modified from a drawing by Carlos Rincón Mautner and David Smee.

TR-508 (THE SANTA MARÍA CANAL)

This canal was first brought to our attention by R. Hernández Garciadiego (personal communication 2003). It closely follows the contours of the east face of the Cerro Lencho Diego (FIG. 1), and based on our transit measurements along its length, its channel gradient was approximately 2.9%. The canal was excavated into the eroded talus materials that accumulated along the face of the Cerro Lencho Diego. The canal is clearly visible for a distance of 500 m, from where it passes west of the Cerro Mequitongo and Cueva Santiago toward the north-northeast where it appears to draw water (the off-take) from the ravine. The reworking of alluvial surfaces along the ravine floor has obscured the precise location of the off-take, which might extend some 1750 m further north-northeast. Downstream, the canal extends southwest of the western periphery, passing about 8 m west of Tr-449 before it empties into the ravine downstream of the Purrón Dam (FIG. 1). The total length of the canal may be about 2450 m.

The gypsum rock face of the Cerro Lencho Diego, modified in places, formed the canal's west wall, and

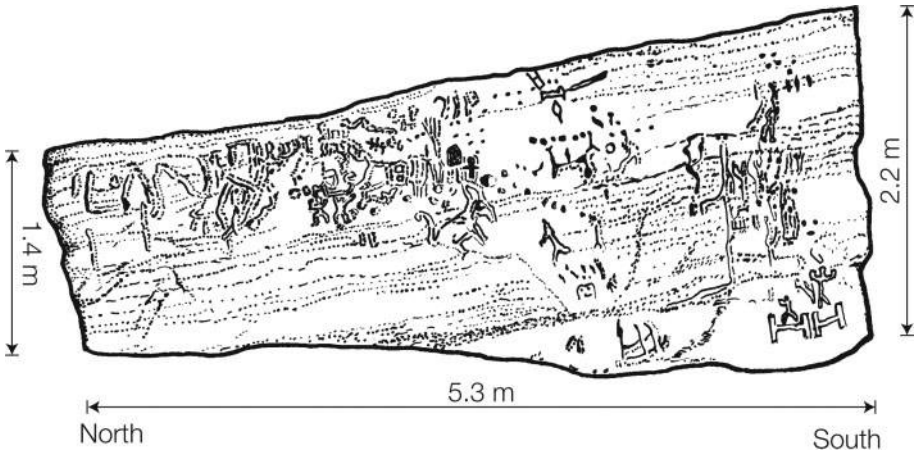

Figure 8 The northeast wall of Cueva Santiago showing the petroglyphs incised and pecked into the gypsum wall. Note the H-shaped elements in the lower right. Modified from a drawing by Carlos Rincón Mautner and David Smee.

the canal's high east berm was formed using the earth and stone from the channel excavation and sediment cleaned from the canal during its use. Two test trenches provided profiles of the canal fill (FIGS. 9, 10). In cross-section the canal channel appears to have been generally U-shaped, ranging from about 1.5 to 6.0 m in width at the top of the channel, about 60 cm in depth from the top of the eastern berm to the top of the channel fill and about 2.0 m in depth to the channel floor. The canal fill consists of bedded fine locally derived gypsic silts from slope wash from the eastern slopes of the Cerro Lencho Diego and coarser siliclastic rounded sands from the ravine watercourse indicating water was derived from both sources. Accelerator Mass Spectrometry dating of charcoal and direct dating of sediments by OSL (TABLE 1) indicate that the canal was functioning by at least the Late Santa María Phase, and occurred after the construction of all four levels of the Purrón Dam. A date from higher in the profile shows that sedimentation within the canal continued into the Middle Classic Period. However, the Late Santa María date does not correspond with earlier surface ceramic dates assigned to most of the habitation sites bordering the canal.

The function of the Santa Maria Canal appears to have been two-fold: to provide water to the sites along its course and to divert water away from the Purrón Dam during repairs and construction as well as to shunt unusually great floodwaters around the dam and reservoir to protect them during heavy rains.

Figure 9 A view down the Santa Maria Canal, about 50 m north-northwest of Cueva Santiago. Here the canal is about 4.5 m wide. Canal Test Trench #1 is seen in the far middleground.

LOCI/SITES ASSOCIATED WITH THE SANTA MARÍA CANAL

The Santa María Canal provided water for a complex of 18 sites, consisting of nine habitation and "administrative" sites, seven agricultural fields, one site (Tr-512) with a small structure in an agricultural field, and one wall alignment (Tr-510) with a canal off-take (FIG. 1). Each habitation/administrative site is situated on a small terrace with sparse vegetation located between the eastern berm of the canal and the lower agricultural terraces. Following MacNeish's policy, we have documented the western periphery sub-area sites as separate loci, rather than as one continuous linear site area of occupation. This is because there are rather distinct separations between each terrace and the sites have varied dates of occupation. An association of the canal and all 18 of the sites seems highly probable. While not in this sub-area, site Tr-449 was also probably associated. Conversely, site Tr-550 was found in the Western Periphery (FIG. 1) but was apparently not directly associated with the Santa María Canal.

While their function is unclear, based on the criteria used by Spencer (1979), five of the 10 habitation sites found aligned with and downslope from the Santa María Canal may also have had "administrative" roles due to their larger size, the presence of stone foundations and/or platforms and mounds, and the artifact assemblage present. Of these "administrative" sites, Tr-523 and Tr-449 have Early Santa María

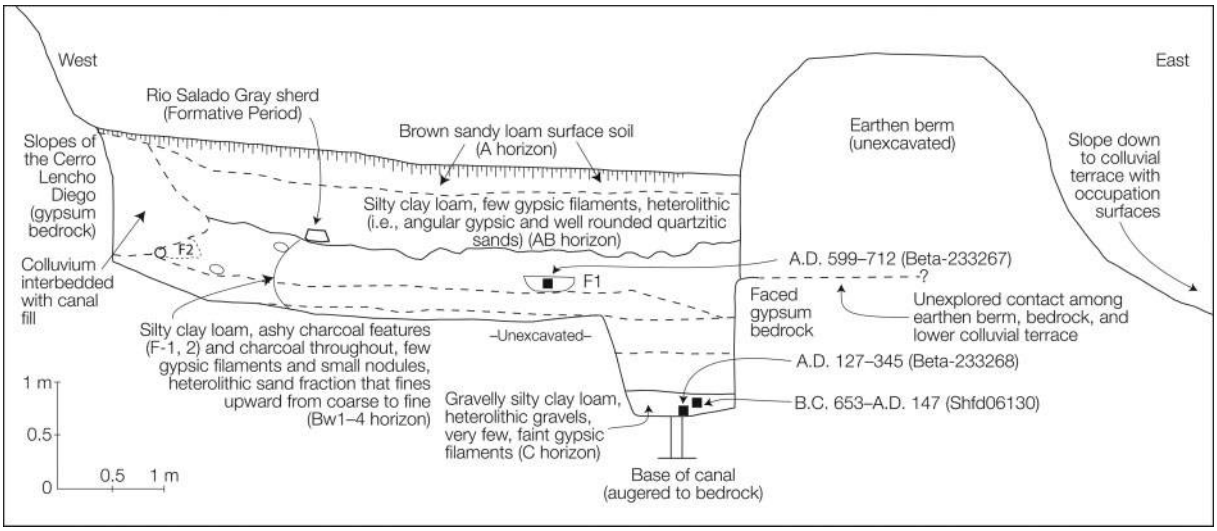

Figure 10 North wall profile of Santa María Canal Test Trench #2, located about 45 m northwest of Tr-523. black squares = radiocarbon and OSL sample locations (see Table 1).

Phase pottery assemblages. Tr-516 and Tr-523 have Middle and Late Santa María Phase ceramics, while Tr-519 and Tr-522 have Late Formative assemblages. Although Formative ceramics were most numerous, a sparse Classic (Early Palo Blanco) assemblage was found at sites Tr-516, Tr-519, and Tr-522, while a larger, yet still relatively low, density Postclassic assemblage was identified at sites Tr-516 and Tr-523.

The habitation terraces ranged in area from about 130 sq m (Ts-513) to approximately 3480 sq m (Tr-523), with an average area of about 1177 sq m (see Marcus 1976 for comparisons). Four terraces with ceramics but without evidence of structures (Ts-513, Ts-515, Ts-517, Ts-524) may have had structures constructed of perishable materials or wattle and daub (MacNeish *et al.* 1972: 352), and have tentatively been labeled as "habitation sites." Foundations of unmodified large cobbles and small boulders, and occasionally shaped stone blocks, were found. In a few cases (Tr-516, Tr-519, Tr-522, Tr-523), small platforms and/or mounds, ranging from about 2 × 4 m to 12 × 22 m, were recorded (FIG. 11). Some of these small platforms/mounds had small structures (averaging about 2 × 4 m) on their summits. Site Tr-523 was clearly the largest site and had the most structures with the most complex construction. Site Tr-512 had a small field house (?) directly associated with an agricultural field.

Eight terraced areas have been identified as agricultural fields/gardens, based on the presence of furrows seen in the irregular subsurface boundary at the base of an "A" horizon at Ts-514, visible gaps in the east wall of the Santa María Canal, a rudimentary off-take feature (Tr-510) located just above Ts-526, and the presence of low linear borders/terraces of rock. All eight of these fields appear to have had some leveling, and each may be associated with one or more adjacent habitation sites. The terraces range in area from ca. 400 sq m (Ts-521) to 3432 sq m (Ts-514), with an average area of ca. 1647 sq m.

None of the sites apparently associated with the canal were directly dated, however, surface collections of ceramics provided good estimates of site occupations. The sub-area saw a possible Ajalpan occupation at Tr-550 and Early Santa María Phase occupations at Tr-523 and Tr-550; however, its densest occupation (all 18 sites) was during the Middle and Late Santa María Phases. An ephemeral Classic (Early Palo Blanco Phase) settlement was indicated at Tr-516, at Tr-519, and possibly at Tr-522. Postclassic (Early to Late Venta Salada) ceramic types were

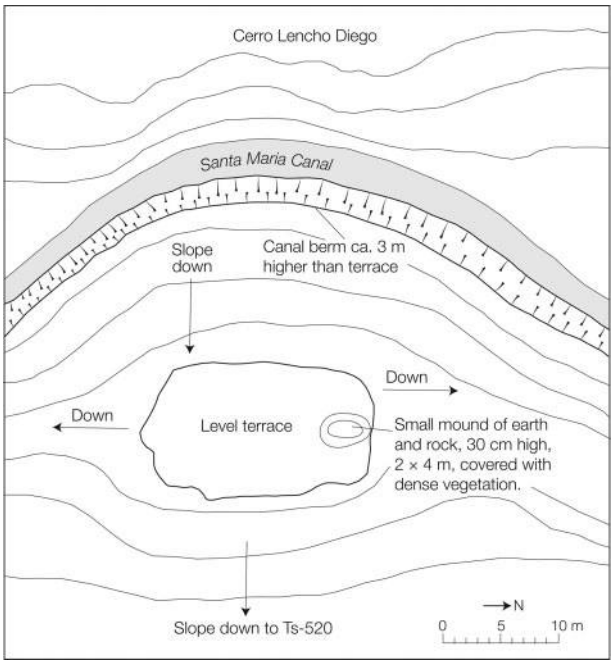

Figure 11 Field map of the Late Formative habitation/ "administration" site, Tr-519, which includes an earth and rock mound.

recovered from 12 of the 18 habitation and agricultural field sites (see online supplement: http://www.maneyonline.com/doi/suppl/10.1179/2042458215Y.0000000010).

Sub-area 3: The ravine floor upstream from Tr-15

Eleven new sites were recorded upstream from Tr-15, dating from the Ajalpan/Early Santa Maria into the Middle/Late Venta Salada Phases. These sites are located on the *ravine* floor between the active channel to the west and the drainage divide caused by the Cerro de la Isla to the east (FIG. 1).

One of these sites (Tr-538) was founded in the Ajalpan or Early Santa María Phase; three (Tr-534, Tr-536, Tr-537) had ceramics from the Middle Santa María Phase, while two (Tr-534, Tr-538) dated to late in that phase. Three of the six sites were habitations, while we tentatively classified a fourth site (Tr-538) as an "administration" site due to the presence of a mostly buried apparently large pyramidal mound. Only two previously occupied sites (Tr-534, Tr-537) in this sub-area were found to have Palo Blanco Phase (Classic Period) ceramics, suggesting only a small and/or seasonal/short duration reoccupation during that Period.

Eight sites (Tr-528, Tr-529, Tr-530, Tr-532, Tr-533, Tr-534, Tr-535, Tr-537) had Postclassic ceramics; three of which (Tr-532, Tr-534, Tr-537) were reoccupations of Santa María Phase sites. A 10 × 15 m platform was built at Tr-532 during the Postclassic. Three (Tr-528, Tr-529, Tr-530) were agricultural fields (FIG. 12). The fields, mostly characterized by linear borders, low terraces, and grid quadrangles of rock (cf., Doolittle and Neely 2004), were situated along lobate alluvial fans or low terraces and in shallow natural drainages (cf., Neely 2005), likely to take advantage of seasonal run-off in the ravine.

Sub-area 4: The eastern periphery of the Barranca Lencho Diego

Four (Tr-539, Tr-540, Tr-541, Tr-542) of the six sites in this sub-area were first recorded by our survey (FIG. 1), while we revisited Tr-451 and Tr-452 that are located on terraces overlooking the ravine and which contain house mounds and stone foundations (Spencer 1979: figs. 2.6, 2.10). Ceramics recovered from Tr-451 suggest a possible Early Santa María Phase occupation and definite Middle and Late Santa María Phase occupations. Tr-541 was a rock wall alignment, probably from a Middle and Late Santa María Phase house. No Classic Period sites were found. Four sites with Early Venta Salada occupations were recorded: Tr-540 and Tr-542 (both small field house-like structures similar to those found in the ravine floor upstream from Tr-15) and reoccupations of sites Tr-451 and Tr-452. Site Tr-539, an undated small earth and stone dam with construction techniques generally similar to Level 1

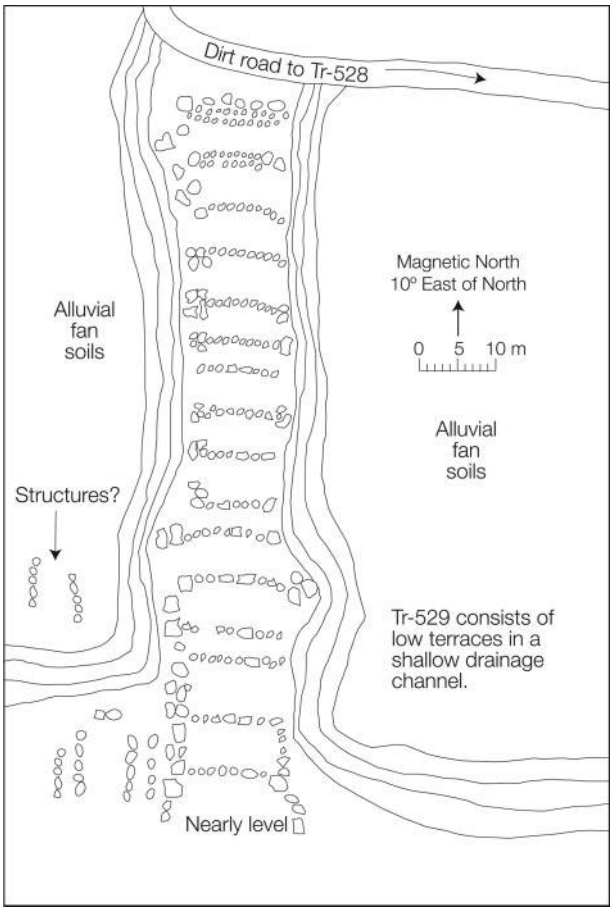

Figure 12 Field map of Tr-529, a Postclassic field situated in a shallow drainage. Stones cleared from the drainage were apparently used to construct the low terraces and armor the sides of the drainage. A possible habitation site was located at the southwest corner of this field area.

(Early Santa Maria Phase) of the Purrón Dam, was found about 160 m northeast (upstream) of Tr-15.

Sub-area 5: The southern periphery of the Barranca Lencho Diego

Along the southern periphery of the ravine, our survey recorded three new sites (Tr-543, Tr-544, Tr-545), and gathered additional information on a site (Tr-453) reported by Woodbury and Neely (1972: fig. 9). Two of the newly discovered sites (Tr-543 and Tr-545) are small sites, each with one small mound/platform that was occupied during the Early through Late Santa María Phases. These two sites are unusual because of their small size relative to the other Formative sites recorded, the presence of a mound at such small sites, and that they may have served as "lookouts" over the south end of the Purrón Dam and its reservoir. Site Tr-544, dating to the Middle/Late Santa María Phase, is an arcuate terrace wall, and was the only site in sub-area 5 to have ceramics suggesting an Early Palo Blanco occupation. The Postclassic saw the reoccupation of sites Tr-453, Tr-543 and Tr-544. Tr-453 is a large site partly within a rockshelter, with numerous stone

foundations of houses, platform mounds, and a 3 × 4 m shaped gypsum block "altar." This large site was occupied during the Late Santa María Phase, as well as the Early, Middle, and possibly the Late Venta Salada Phases (FIG. 3). It is the largest Postclassic site in the PDC.

Sub-area 6: The ravine floor downstream from the Purrón Dam

Six sites, three of which were identified post-1964, were recorded (FIG. 1). Tr-449, apparently associated with the Santa Maria Canal, was the earliest habitation site in this sub-area, dating to the Early and Middle Santa Maria Phase and possibly to late in that phase as well, and was classified as a "habitation-administration" site (Spencer 1979: 24–28, fig. 2.4). Tr-67 (Spencer 1979: fig. 2.7) is a site with broad terraces descending west in a stair-step fashion toward the Río Salado; it supported many houses and had cultivated gardens and fields, some of which were irrigated. This site has a possible Early Santa Maria Phase occupation, definite Middle and Late Santa María Phase occupations, as well as an Early Venta Salada occupation (FIG. 3). The function of Tr-450, a large Middle and Late Santa María Phase mound at the northwest end of the Purrón Dam, remains an enigma, although it was labeled as a "public building" by Spencer (1979: 30, fig. 2.7). Tr-546 (Spencer 1979: fig. 2.7) is an Early and Middle Venta Salada Phase site that overlies a portion of site Tr-67. It has two ca. 20 × 24 m platforms each supporting a small centrally situated structure. We were not able to date Site Tr-547, a stone-lined, mostly buried canal, but it probably was excavated in the Early/Middle Santa María Phase to service site Tr-67. It was possibly also used during the Late Santa María Phase and in the Early and Middle Venta Salada Phase to service site Tr-546 and the later fields cultivated on Tr-67. Tr-548 is a rock-lined canal visible only in the profile of the ravine about 80 m west of the Purrón Dam. It courses southwest across site Tr-67 and probably supplied domestic and irrigation waters to that site. Based on its location, Tr-548 may be a continuation of the Santa María Canal (FIG. 1). These two canals are cut into, and buried by, high-energy alluvial channel deposits. These deposits represent the natural processes of the watercourse, whether or not they came from catastrophic events after the breaching of the Purrón Dam can only be determined by future investigations.

Diachronic Synthesis of Prehistoric Settlement in the Barranca Lencho Diego

The discovery of many sites and the acquisition of new radiometric dates demand a re-evaluation of the existing model of chronology and settlement patterns in the PDC. The long archaeological record in the Barranca Lencho Diego registers a deep history of human settlement. Our understanding of major shifts in subsistence strategies and sociopolitical organization in the PDC is augmented by existing interpretations of paleobotanical remains found in stratified deposits in Purrón Cave (Tc-272) (MacNeish and García Cook 1972; Smith 1967). Our chronological framework is derived from MacNeish *et al.* (1972), and summarized by MacNeish in 2001 (FIG. 3), and greatly refines the existing chronological synthesis.

During the Ajalpan Phase (ca. 1500–850 B.C.) of the Early Formative period the small group occupying Purrón Cave practiced traditional maize agriculture and used simple water management in the form of small dams such as the initial construction of Tr-15, and perhaps Tr-501/Tr-502, initiating the trajectory of larger, more complex water management in the ravine. It is feasible that the largely buried sites of Tr-550 and Tr-538, found near the northwest portion of Tr-15 and which may be identified as "Waterway Hamlet" settlements, have an Ajalpan Phase component, like that tentatively assigned to the Cueva Santiago; however, excavations, more robust chronological control, and increased knowledge of rock art styles would be required to say for certain. Nevertheless, the Ajalpan date is supported by other early water management systems in the Tehuacán Valley (Caran *et al.* 1996; Neely in press; Neely and Castellon Huerta 2014; Neely *et al.* 1995), Mesoamerica (Doolittle 1990, 2004; Flannery 1983), and the American Southwest (Damp *et al.* 2002; Mabry 2008).

Our survey increased the total number of known Santa María Phase habitation sites within the PDC from the four discussed by Spencer (1979: 30, Table 2.1—who considered Tr-450 to be a form of "public building") to 23 (online supplement: http://www.maneyonline.com/doi/suppl/10.1179/2042458215Y.0000000010), with 7 of these sites occupied throughout that phase.

With the advent of the Early Santa María Phase (ca. 850–650 B.C.) the population had increased; represented by seven well-documented habitation sites, the Cueva Santiago, and Zone I in Purrón Cave. Their agriculture continued to be maize dominated, and water management techniques had not changed save for additional constructions illustrated by Level 1 of the Purrón Dam (with a reservoir volume of about 14,714 cu m), and other small dams (including Tr-501/Tr-502).

During the Middle Santa María Phase (ca. 650–450 B.C.) site loci were larger and more complex. In addition to the Cueva Santiago, there was a significant increase in the number of habitation loci during the transition from the Early (seven sites) to the Middle (17 sites) Santa María Phase; however these sites lack clear evidence of all but the most

basic social differentiation, craft specialization, or aggregation, which are anticipated in models that link intensive water management with emerging social complexity. The first recognizable small field/garden areas appear on artificially leveled terraces in the western periphery sub-area. Based on the botanical findings from Zone H in Purrón Cave, the agricultural complex was still maize dominated, but had expanded to include "exotic" domesticates (i.e., white sapote, black sapote, cotton, and avocado) that would have required irrigation to survive in this locale (Smith 1967: 228; Woodbury and Neely 1972: Table 12). Also during this sub-phase the collection of agave surges, and its continued prevalence suggests that it was a tended or semi-domesticated plant.

During the Middle Santa María Phase there was an increase in the size and complexity of water management technology illustrated by the construction of the second and third levels of the Purrón Dam (with a reservoir volume of about 216,216 cu m), Tr-15, and probably the Santa María Canal (Tr-508). In addition, while future dating will be required to secure the initial findings, the fine-grained sediments immediately above the Level 3 fluvial deposits (see above) could only have accumulated in the low-energy depositional contexts behind the Purrón Dam after Level 4 was built. The OSL dates from these sediments suggest that the maximum volume of the dam (ca. 390,000 cu m), and its maximum reservoir volume of about 979,740 cu m, date to the Middle Santa María Phase. The contemporary occupants of site Tr-131 (Spencer 1979: 34–38, figs. 2.8, 2.9), and from the Coxcatlan Cave (Woodbury and Neely 1972: fig. 5) area may have cooperated in the construction of the Purrón Dam's Level 4. Both Tr-131 and Coxcatlan Cave (Tc-50) are located outside of the Barranca Lencho Diego, about 1.3 and 4 kilometers, respectively, to the northwest and north of the PDC, but the pass through the Cerro Lencho Diego we discovered during our survey (FIG. 1) would have facilitated access into the ravine.

By the Late Santa María Phase (ca. 450–150 B.C.) the number of habitation sites had increased to 21, in addition to the Cueva Santiago. Although not as great as in the previous phase, the 29.4% increase in habitation sites is still impressive. During this phase botanical samples from Level G of Purrón Cave indicate that agriculturalists continued to cultivate exotic plants, several new domesticates (e.g., squash, ciruela, and *Jatropha neopauciflora*) were added, and that the overall production of comestible and otherwise useful plants greatly increased.

During the subsequent Classic Period (ca. 150 B.C.–A.D. 700), a sharp decline in the number of settlements within the ravine is likely reflective of both local and regional influences. Only four habitation sites were found: three were located along the western periphery (Tr-516, Tr-519, Tr-522) and one (Tr-537) was found upstream from Tr-15 on the ravine floor. All four had very small, possibly seasonal, occupations. Ceramics from Level 4 of Purrón Dam and Tr-15 indicate that some repairs may have occurred, while the uppermost radiocarbon date from the Santa María Canal suggests that it may have continued to function during this period. Plant remains from Zones F, E, and D in Purrón Cave (ca. 50 B.C.–A.D. 250) (MacNeish and García Cook 1972: 73, 131–133; Smith 1967: 228–230) indicate a general increase in plant production early in this period, with much the same Santa Maria complex of plants being grown. Although it may not have functioned as originally designed, it is feasible that the Purrón Dam and its reservoir formed a type of water storage feature such as that reported by Fairley (2003), and that the reservoir of the Purrón Dam still provided enough moisture to grow the exotic crops. However, the plant remains from the subsequent Zones C, B, and A (ca. A.D. 100–500) indicated a sharp decrease in the numbers and species grown (Woodbury and Neely 1972: Table 12), with staple, subsistence-based crops (e.g., maize and agave) predominating**.** The absence of evidence for plants requiring irrigation from these three upper zones of Purrón Cave suggests that the Purrón Dam no longer functioned by ca. A.D.100. Purron Cave was abandoned late in the Classic Period by ca. A.D. 500.

The majority of the occupants of the PDC apparently moved about 1.0 km west to the mountaintop sites (Tr-73 and Tr-79) (Spencer 1979: figs. 2.11, 2.12) early in the Classic Period. The reason for this move is not known, but possibly resulted from the loss of the Purrón Dam, or due to political pressures from the Valley of Oaxaca (Marcus and Flannery 1996: 203–206; Spencer and Redmond 1997: 600–603). Climatic studies **(**Bhattacharya *et al.* 2015), near the large site of Cantona, located about 125 kilometers north of the PDC, have revealed regional drought cycles occurring as early as ca. A.D. 500, which may also have played a role in the shift of the PDC population closer to the Rio Salado and an area of springs.

The Early Venta Salada Phase (ca. A.D.700–1150) of the Postclassic Period saw a rapid resettlement of the PDC that apparently lasted until late in that phase. In some instances, resettlement is perhaps a too general concept as some of the Postclassic sites in the complex were used in novel ways (e.g., a platform mound and pyramid complex were placed atop the Purrón Dam and mounds were placed atop Tr-15). A total of 25 sites with diagnostic artifacts were identified, the most notable being the large site of Tr-453 and the pyramid complex atop the Purrón Dam. About 64% of these sites were reuses

of previously occupied sites. PDC sub-area 3 saw a marked expansion, with the establishment of agricultural field areas along the lobes of alluvial fans and in shallow intermittent drainages (FIG. 12). These agricultural fields, many with well-placed stone alignments, appear to have been passively utilizing rainfall and run-off suggesting the non-irrigated cultivation of maize, and possibly beans, squash, chilis, agave and opuntia. Unfortunately, as the occupation of Purrón Cave ended during the Classic Period, there are no available botanical remains to provide tangible evidence for the agricultural strategy changes indicated by the Postclassic field locations. The Santa María Canal may have functioned during this period, as many of the sites and agricultural fields along the western periphery show evidence of Postclassic reoccupation. Further work, including intensive pollen studies, is necessary to determine what crops were grown in the small Postclassic fields in sub-area 3 and the gardens in sub-area 2.

Conclusions

In an attempt to follow the tenets of full-coverage intensive survey (Fish and Kowalewski 1990), the present project has recorded many additional sites and collected other information that has refined our knowledge and understanding of the chronological development as well as the settlement systems associated with water management technology in the PDC area. Perhaps the most important contribution of our study is the clarification of the nature of the socio-political milieu in which the construction of the PDC took place.

The results of our study challenges the dataset underlying the theoretical discourse that links the rise of elites and a more complex sociopolitical system to agricultural intensification. A small, but significant, number of direct dates by OSL from sediments impounded behind the Purrón Dam and radiocarbon dates from strategic loci within the PDC indicate the dam was built entirely during the Formative Period, and that construction did not extend into the Early Classic as originally thought. The number of sites in direct association with the PDC was increased by our efforts from eight to 57. Forty-six of those sites date to the Formative Period, and most are small with only a few households and only a few have small mound groups. The population is seen as living in dispersed corporate local communities or farmsteads/households. These corporate local communities are envisioned as small egalitarian groupings of people living in separate localities that cooperated in activities that provided mutual benefits to all participants. Corporate groups (which this study espouses) are different from corporate societies. Corporate groups are small clusterings of people, living in separate locations that cooperate to attain a common good. During the Early Classic, by contrast, local communities become aggregated with clear signs of ranking, craft specialization, and monumental architecture. These new data, based on survey and test excavations, appear to discredit the existing top-down models of agricultural intensification. Instead, the largest prehistoric water management feature in Highland Mesoamerica appears to have been built by dispersed communities of small corporate groups during the Early and Middle Formative. This challenges Spencer's (1979) assertion that the largest construction phase of the dam was accomplished by a ranked society with a managerial elite. It also casts doubts on the long-standing notions about what level of social complexity is required to facilitate agricultural intensification and large-scale public works.

This explanation is corroborated by prior ethnographic studies (e.g., Hunt 1988; Lansing *et al.* 2009), and is sympathetic to C. Erickson's (2006) challenge to archaeologists to take a bottom-up and landscape perspective when addressing issues of agricultural intensification, political economy, and social complexity. Citing multiple ethnographic studies from a global perspective, Erickson (2006) identified many examples of small-scale societies, constructing and managing large-scale agricultural systems without a central authority.

The household and village were the primary decision-making entities in the construction of water management systems in Mesoamerica and the American Southwest (e.g., Enge and Whiteford, 1989; Evans 1990; Hunt 1972; Hunt and Hunt 1974; Hunt *et al.* 2005; Kirkby 1973; Mabry 2008; Neely 2014, in press; Neely and Castellón Huerta 2014; Pérez Rodríguez 2006; Ramirez Sorensen 1996; Smith and Price 1994). Based on the settlement patterns associated with the PDC and the above studies, this pattern of household/village-level decision-making evidently existed from the Formative Period into the Modern Period in Highland Mesoamerica.

Why would the PDC community have undertaken such a massive construction? Botanical remains in the nearby Purrón Cave show that during the Formative Period many tropical exotics were being grown in the geographically and climatologically restricted southern end of the Tehaucán Valley. Farmers in the PDC may have been focused on the production of exotic foodstuffs for trade. Trade of these tropical exotics, possibly from the PDC, has been documented at the Formative Period site of Quachilco, located about 26 km to the north-northwest of the PDC (Smith 1979: 218–222). Further work is necessary to test this hypothesis to determine what may have been the reciprocal items of trade. Was it obsidian as Spencer (1979) suggests?

The dam and associated water management systems would have been very impressive constructions and the associated farmscapes (Morehart 2010) would have been quite conspicuous. Such constructions by corporate groups could have served to display and reinforce community solidarity, like that proposed by Carballo and colleagues (2014) and Scarborough (2006). The early date of the PDC and the nature of its settlement pattern appears to corroborate Carballo and colleagues's (2014) model of the decision making process of small corporate communities facilitating large-scale projects, and that the possible unintended consequence was the rise of social complexity (Joyce 2004). The placement of a Postclassic pyramid atop the Purrón Dam perhaps served to legitimize sociopolitical status by co-opting what would have then been an ancient structure into a new sociopolitical system, while the range of petroglyph styles in Cueva Santiago perhaps reflect changing relationships between people, and their built environment.

Finally, when did the dam fail and how did the use of the PDC change through time? There are multiple lines of evidence (e.g., the rapid rate of silt filling the reservoir, the disappearance of exotic botanical remains from the late occupation zones of Purrón Cave) that indicate that the dam essentially ceased to operate by the end of the Formative Period. As a result, the socially stratified Early Classic communities probably had a different basis for their economy than that of the preceding settlement. The botanical samples from Purrón Cave's Zones C-A indicate a movement away from the production of exotic domesticates in the Classic Period and instead a focus on staple crops that would have required a far less specialized agrosystem. The sparse evidence for occupation in the PDC and large aggregated communities outside the PDC (i.e., Tr-73 and 79) indicate the PDC was largely abandoned during the Classic Period. Today, the Barranca Lencho Diego is used for pasturage, hunting, and the collection of wild and semi-domesticated plant resources. Settlement and agricultural systems can have deleterious impacts on agricultural production (McAuliffe *et al.* 2001), and the failure of large-scale systems, regardless of the cause, can have unintended long-term consequences (Borejsza *et al.* 2011; Fisher 2005; Joyce and Goman 2012; Leigh *et al.* 2011).

While our work has raised as many questions as it has answered, the PDC is seen to be a remarkable example of agricultural intensification by small cooperating corporate groups during the Formative Period to facilitate the cultivation of maize, probable semi-domesticates (e.g., agave, chupandilla fruit), and a specialized production of tropical species in an arid environment. As the culmination of probable trial and error over time, the development and expansion of water impoundment structures in the Barranca Lencho Diego provided the water necessary to support local and exotic agriculture, which in turn supported Formative Period occupations that were more numerous than archaeologists originally thought. Abandonment in the Classic Period is still unexplained, but was likely due to a combination of dam failure and region-wide political upheaval that affected the settlement pattern, and a regional drought cycle may also have played a role.

Reoccupation of the ravine during the Postclassic Period shows a return to agriculture in the PDC, but of a type more typical of arid lands, primarily dry-farming and the manipulation of local drainage patterns to most likely conduct the cultivation of the more prevalent domesticates and semi-domesticated plants. This is an unusual case study that illustrates that agricultural intensification is not concomitant with socio-political complexity, and provides an example of agricultural production and intensification that became less complex through time.

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Characteristics of archaeological loci and sites that comprise the Purrón Dam Complex.

Survey Area, Locus/Site Number and Name	GPS location (WGS 84) and References.	Locus/Site type	Locus/Site size/area	Architecture present	Ceramics present	Artifacts present	Phases of occupation	Comments
The Dam and Reservoir Area								
Tr-15 = Coffer Dam	14Q, 0699199, 2011022. MacNeish, Peterson, and Neely 1972, Woodbury and Neely 1972.	Large, long, arc-shaped "cofferdam" bordering outer edge of reservoir.	Structure width = ca. 30 m, height = ca. 5 m, total length = ca. 350 m.	Red/brown sandstone blocks overlying tannish/white gypsum slabs.	Canoas white, orange-brown, heavy plain; Coatepec white; Rio Salado coarse, gray; Quachilco gray; Coxcatlan brushed, coarse.	See Woodbury and Neely 1972.	Probable Ajalpan. Early, Middle, and Late SM. Early PB. Early VS, Middle VS.	See Woodbury and Neely 1972. Two post-1964 test trenches, each 2 m by 2 m, excavated at the structure's west end.
Tr-435 = Purrón Dam.	S. Face = 14Q, 0699140, 2010669. MacNeish, Peterson, and Neely 1972, Woodbury and Neely 1972.	Very large dam, forming large reservoir.	Dam = 400 m long, 106 m wide, 21 m high.	Cobble and boulder cellular construction, west side faced with cut stone.	Canoas white, heavy plain, orange-brown; Coatepec white; Rio Salado coarse, gray; Coxcatlan brushed, polychrome; Texcoco B/R.	See Woodbury and Neely 1972.	Early SM, Middle SM, Late SM. Late PB. Early VS, Middle VS.	See Woodbury and Neely 1972.
Tr-501/502.	14Q, 0699232, 2010820 and 14Q, 0699307, 2010698	Two segments of one long dam,buried in Purrón Dam reservoir.	2.5 m high, 12 m wide. Exposed in two arroyos about 100 m apart.	Six vertical retaining walls (single courses of cobbles) with cells filled with siltstone pebble gravels.	None.	None	Pre-Phase III of Purrón Dam = Probably Early SM.	Capped by coarse alluvial gravels that correlate to Phase III of Purrón Dam. We infer they make up two exposures of same dam based on elevation, stratigraphic position, and similarities in architecture
Tr-503.	14Q, 0699264, 2010886.	Small dam, buried in Purrón Dam reservoir.	1.4 m high by 3.4 m wide.	Dry-laid, angular, unshaped gypsum slabs.	None.	None	Pre-Level IV of Purrón Dam = Late SM.	Buried by 3 m of alluvium.
Tr-504	14Q, 0699310, 2010976.	Post-Classic platform.	Mostly buried.	Stone and earth platform.	Coxcatlan brushed, gray, and coarse.	Few chert, and gray and green obsidian flakes.	Early VS, Middle VS. Possible Late VS.	Situated immediately south of (partly overlapping?) Tr-15.
Tr-505	14Q, 0699336, 2010981.	Small dam, partly buried in Purrón Dam reservoir.	About 5.2 m wide by 1.2+ m high.	Unmodified (?) slabs and blocks of gypsum (?).	None.	None	Probably Early SM, Middle SM.	NW–SE orientation? Partially buried. Found immediately south of Tr-15.
Tr-506	14Q, 0699282, 2011026.	Platform mound with 4 structures and one possible small, low mound atop in NE quadrant of locus.	Platform = 23 m (E–W) by 36 m (N–S). Structures 2.5 by 2.8 and 3 m by 3.1 m.	Stone and earth platform with small mound and structures; all atop structure Tr-15.	Abundant Post-Classic types, including Coxcatlan brushed, gray, and coarse.	Few chert and gray and green obsidian flakes. Stone celt.	Early VS, Middle VS, and probable Late VS.	Construction = unmodified cobbles and boulders, with some cut and pecked blocks. Constructed atop Tr-15.
Tr-507	14Q, 0699214, 2011008.	Platform with a low mound at its SE corner and a house platform at its SW corner.	Platform = ca. 24 m by 34 m. SE mound = ca. 9 m by 13 m, SW house platform = ca. 3 m by 6 m.	Earth and stone platform, with an earth mound and house platform.	Canoas white, orange-brown; Quachilco mica, brown, and gray; Coxcatlan brushed, gray, coarse, and polychrome; Texcoco B/R.	Few chert and obsidian flakes, one gray obsidian blade fragment.	Middle SM, Late SM. Early VS, Middle VS, and probable Late VS.	Total area of platform = ca. 816 m^2. Situated immediately south of (partly overlapping?) Tr-15.
Tr-549	14Q 0699207, 2010818.	Buried rock wall or structure.	About 1.7 m high by 14.5 m wide.	Dry-laid tabular gypsum blocks (about 20 by 18 by 8 cm in size).	None.	None	Constructed post-Level 3 and pre-Level 4 of Purrón Dam = Late SM.	Construction like TR-15. Capped by 2.5 m of silt. Isolated structure found across *barranca* from Tr-501.

Western Periphery								
Tr-508 = Santa Maria Canal	Head = 14Q, 0699099, 2011552. Tail = 14Q, 0698987, 2010926.	Canal cut into toe of Cerro Lencho Diego, with a high berm to the East.	Variable width = ca. 3 m to 6 m, depth = ca. 2 m, and ca. 500 m in traceable length.	Visible cut marks in bedrock gypsum on both walls of canal.	One sherd of incised Rio Salado gray found in test trench #2 fill.	Few flakes and chipping debris of chert.	Probable Early SM. Middle SM, Late SM. Possible Early PB.	Excavation debris used to build and reinforce top of east berm. Dated on basis of ^{14}C and OSL samples.
Tr-509	14Q, 0699103, 2011505.	House foundation atop the east berm of canal (Tr-508).	House foundation = ca. 2 by 2 m.	Unmodified boulder foundation.	Coatepec white; Quachilco gray.	None.	Middle SM, Late SM.	Possibly associated with agricultural field Ts-527. Pass to Tr-131 & Tc-50 just to northwest.
Tr-510	14Q, 0699108, 2011425.	Rock wall alignment with a canal off-take *(vertedero)*.	Total alignment length = 39 m. Off-take = 80 cm wide.	Alignments of unmodified cobbles and boulders.	None.	None.	Middle SM, Late SM.	Off-take to Agricultural Field Area Ts-526. Dating based on sherds from Ts-526.
Tc-511 = Cueva Santiago	14Q, 0699084, 2011107.	Human-cut cave *(cavate),* with 2, possibly 3, rooms.	Front room = 5.7 by 5.8 m, 2nd room = 1.25 by 5.7 m.	Wall surface cut marks indicate human construction.	Canoas White; Quachilco gray; Coxcatlan brushed, gray, coarse; Teotitlan incised.	Few small chert and gray obsidian flakes.	Possible Ajalpan. Early SM, Middle, and Late SM. Early VS, Middle VS.	Probable platform at entrance. Many petroglyphs on walls, some thought to be Archaic in date.
Tr-512	14Q, 0699157, 2011109.	One-room house at SW corner of agricultural field terrace.	House = 1.7 by 2.0 m. Terrace = ca. 24 m E–W by 50 m N–S.	Unmodified cobbles and boulders used in house construction.	Rio Salado coarse; Coatepec white.	Few chert flakes. One gray obsidian flake.	Middle SM, Late SM. Early VS, Middle VS. Possible Late VS.	Only agricultural field with a structure (field house?) directly associated.
Ts-513	14Q, 0699122, 2011163.	Small terraced area. Probable habitation site.	Terrace = 10 m (E–W) by 13 m (N–S). Area = 130 m^2.	No surface structures. Possible perishable or wattle and daub structures?	Few sherds. Quachilco gray; Coxcatlan brushed.	Few chert flakes.	Late SM. Early VS.	About 60–70 m north of the Cueva Santiago (Tc-511).
Ts-514	14Q, 0699088, 2011175.	Irregularly shaped terraced area. Probable agricultural field area.	Terrace = ca. 52 m (E–W) by 66 m (N–S). Area = ca. 3,432 m^2.	None. Probable agricultural furrows exposed in test pit.	Canoas white; Quachilco gray; Coxcatlan brushed and gray.	Few chert flakes.	Middle SM, Late SM. Early VS.	Situated between Cueva Santiago (Tc-511) and Site Tr-505. Bordering Santa Maria Canal (Tr-508).
Ts-515	14Q, 0699150, 2011180.	Terraced area. Probable habitation site.	Terrace = 54 m (E–W) by 29 m (N–S). Area = 1,566 m^2.	No surface structures. Possible perishable or wattle and daub structures?	Many SM, few VS sherds. Canoas/Coatepec white; Rio Salado coarse, gray; Quachilo brown, gray; Coxcatlan brushed, gray.	Many chert, few obsidian (green and gray) flakes. Basalt celt.	Middle SM, Late SM. Early VS, Middle VS.	Santa Maria Phase ceramics predominate.
Tr-516	14Q, 0699141, 2011217.	Terraced area with 20 cm high platform, with a mound with a possible structure on top. Habitation-Administration site.	Terrace = 24 m (E–W) by 45 m (N–S). Platform mound = 7 m (E–W) by 14 m (N–S).	Low platform mound about 7 m by 14 m. Has a possible structure on top.	Many sherds. Mostly VS, many SM, very few PB. Rio Salado coarse; Coatepec white; Quachilco mica, gray; El Riego gray; Quachilco red; Coxcatlan brushed, gray, coarse.	Many chert flakes, many obsidian (gray) blades with ground platforms. One Tequemolera.	Middle SM, Late SM. Early PB. Early VS, Middle VS. Possible Late VS.	Total area of site = ca. 1,080 m^2. Both unmodified cobbles and cut/pecked block construction. Platform mound at north end of terrace.
Ts-517	14Q, 0699174, 2011231.	Terraced area. Probable habitation site.	Terrace = 8 m (N–S) by 73 m (E–W). Area = 584 m^2.	No surface structures. Possible perishable or wattle and daub structures?	Canoas/ Coatepc white; Coxcatlan brushed and gray.	Few chert flakes.	Middle SM, Late SM. Early VS.	SM is predominant occupation.
Ts-518	14Q, 0699128, 2011263.	Terraced area. Probable agricultural field.	Terrace = ca. 30 m (N–S) by 40 m (E–W).	None.	Canoas heavy plain; Quachilco brown, gray.	Few chert flakes. No obsidian seen.	Middle SM, Late SM.	Situated between Sites Tr-516 and Ts-517.

Tr-519	14Q, 0699123, 2011283.	Terraced area with 20 cm high platform mound w/ house on top. Habitation-Administration site.	Terrace = 25 m (E–W) by 17 m (N–S). Platform mound and house = 2 m (E–W) by 4 m. Area of site = 425 m^2.	One low platform mound with a structure. Situated at north end of terrace.	Few sherds, mostly Quachilco Gray. Only a few El Riego Gray and Quachilco Red.	Few chert and gray obsidian flakes and blades. One ridge-backed, one-hand mano.	Late SM. Early PB.	Construction = unmodified cobbles and boulders, as well as shaped cut /pecked blocks.
Ts-520	14Q, 0699166, 2011290.	Terraced area. Probable agricultural field.	Field = ca. 30 m (N–S) by 50 m (E–W). Area = ca. 1,500 m^2.	None.	Canoas orange-brown; Coatepec white; Quachilco gray and brown; Coxcatlan coarse.	Few chert flakes.	Middle SM, Late SM. Possible Middle/Late VS.	Field east of Site Tr-519.
Ts-521	14Q, 0699135, 2011299.	Terraced area. Probable Agricultural Field.	Field = ca. 20 m N–S by 20 m (E–W). Area = ca. 400 m^2.	None.	Rio Salado gray; Quachilco gray and brown; Coxcatlan coarse.	Few chert flakes.	Middle SM, Late SM. Possible Middle VS.	Field south of Site Tr-519.
Tr-522	14Q, 0699137, 2011324.	Terraced area with low platform mound. Habitation-Administration site.	Terrace = 50 m (E–W) by 35 m (N–S). Area = ca. 1,750 m^2.	Low platform mound about 7 m by 14 m, at north end of terrace.	Few sherds. Quachilco gray, red.	Few chert and gray obsidian flakes.	Late SM. Possible Early PB.	Very dense cacti vegetation in north-central part of site may hide structures.
Tr-523	14Q, 0699129, 2011356.	Two terraced areas with a small platform mound and eight houses. Habitation-Administration Site.	Total size of site = ca. 58 m (N–S) by 60 m (E–W). Total area = ca. 3,480 m^2.	Low platform (12 by 22 m) with two mounds atop (4 by 7 m and 8 by 10 m) at SE corner of upper terrace. Three stone houses to north of platform (1.2 by 2 m to 2.25 by 3.2 m	Many sherds. Canoas/Coatepec white; Canoas orange-brown; heavy plain; Rio Salado gray, coarse; Quatepec white-rimmed black; Quachilco mica, brown, gray; Coxcatlan brushed, gray, red, coarse.	Few chert and obsidian flakes, very few obsidian blades. Basin metate fragment.	Possible Early SM. Middle SM, Late SM. Early VS, and possible Middle VS.	Occupies two terraces. Largest and most complex Formative site of Purrón Complex. Lower terrace to east of platform has four stone-founded houses (2.3 by 4 m to 3.5 by 3.8 m). Made of both unmodified and shaped building stones.
Ts-524	14Q, 0699144, 2011383.	Habitation Site on a small terraced area.	Size of terrace = ca. 20 m by 20 m. Area = ca. 400 m^2.	None seen. Possible perishable or wattle and daub structures?	Rio Salado coarse; Quachilco brown and gray; and Coxcatlan brushed.	Twenty fragments of green and gray obsidian, 12 blades (1 green w/ground platform).	Middle SM, Late SM. Early VS, and possible Middle VS.	Probable habitation site surrounded by Sites Tr-522 and Tr-523, as well as Fields Ts-525 and Ts-526.
Ts-525	14Q, 0699173, 2011382.	Terraced area, probable agricultural field.	Terrace = ca. 36 m (N–S) by 67 m (E–W). Site area = 2,345 m^2.	None.	Few sherds seen. Quachilco gray; Coxcatlan brushed.	None seen (due to heavy vegetation?).	Mostly Late SM, few Early VS.	May have an off-take from Sta. Maria Canal. Associated (?) with Site Ts-524.
Ts-526.	14Q, 0699140, 2011402.	Terraced area associated (?) with Site Tr-510. Agricultural Field Area.	Terrace = ca. 50 m (N–S) by 42 m (E–W). Site area = ca. 2,100 m^2.	None.	Rio Salado coarse; Quachilco gray, and brown; Coxcatlan gray, brushed.	None.	Middle SM, Late SM. Early VS.	Vertedero Tr-510 located near west edge of terrace. This field is located just north of large site Tr-523.
Ts-527	14Q, 0699126, 2011475.	Terraced area, probable agricultural field.	Terrace = ca. 20 m (E–W) by 50 m (N–S). Site area = 1,000 m^2.	None.	None.	None.	Probable Middle SM, Late SM.	Situated east of Santa Maria Canal. The nearby Tr-509 may be associated. Dating based on association with Tr-509.
Tr-550	14Q, 0699137, 2010998. Woodbury and Neely 1972: 93.	Irregularly shaped terraced area with small structure and a possible agricultural garden or field.	Terrace = ca. 12 m (N–S) by 40 m (E–W). Total area = ca. 480 m^2.	Cut/shaped block foundation of a 2.2 m N–S by 3 m E–W structure near center of terrace. Tr-15 Western Sluice to east.	Canoas white, orange-brown, heavy plain; Rio Salado gray, coarse. Quachilco mica, gray; El Riego gray; Coxcatlan brushed, gray.	One smoky-gray obsidian blade with a ground platform.	Possibly Ajalpan. Early SM, Middle SM, Late SM. Early VS.	Early component of site probably associated with west end of Tr-15. Post-Classic structure surrounded by possible gardens?

Barranca Floor up-stream from Tr-15								
Tr-528	14Q, 0699355, 2011515.	Habitation structure, with associated terraced gardens/fields.	Site = ca. 20 m (E–W) by 60 m (N–S). Structure = 2.1 m (E–W) by 4.2 m (N–S).	Large cobbles and small boulders, some of which were shaped, used in the construction of the structure.	Coxcatlan gray, and coarse; Texcoco Black-on-Red.	Few flakes and shatter of chert. No obsidian.	Early VS, Middle VS.	House foundation at SE corner of garden/field area. Field area characterized by rock piles (up to 5 m in diameter and 50 cm high) and low terraces. Are rock piles field cleaning debris or structures?
Tr-529	From 14Q, 0699306, 2011528 to 14Q, 0699285, 2011451.	Two structures with associated gardens/fields of low terraces and check-dams in a drainage. Large rock pile (dia. 8 m) to SE.	Site = 30 m (E–W) by 125 m (N–S). Structures = ca. 4 m (N–S) by 4 m (E–W).	Cobbles and boulders, used in construction of structures and gardens/fields.	Coxcatlan brushed, gray, red, and coarse; Texcoco Black-on-Red.	Few chert flakes. No obsidian. One stone "hoe," one "chopper."	Early VS, Middle VS.	Structures at southwest corner of garden/field area. Is rock pile field cleaning debris or a structure?
Tr-530	14Q, 0699267, 2011459.	One house structure with associated gardens/fields.	Structure = 5 m (N–S) by 3 m (E–W). Site size = ca. 30 m (E–W) by 60 m (N–S).	Large, unmodified cobbles and boulders.	Coxcatlan brushed, red, gray, coarse; Teotitlan incised; Texcoco black/red, *xantiles,* and flat vessel supports (some w/stamped designs).	Chert and obsidian flakes, few gray obsidian blades (most w/ground platforms).	Early VS, and Middle VS.	Varied types of rock alignments for gardens/fields, house situated at SE corner of garden/field area.
Tr-531	14Q, 0699397, 2011398.	Two one-room boulder structures.	Structures = 1.8 m (N–S) by 2 m, and 2.5 m (N–S) by 3 m. Site size = ca. 225 m^2.	Unmodified cobbles and boulders used in construction.	Coatepec white-rimmed black; Quachilco mica, brown, and gray;	Few chert flakes and shatter. No obsidian.	Late SM.	125 m SE of Tr-516. Area of sherd scatter = ca. 15 m by 15 m. (225 $m^{2)}$
Tr-532	14Q, 0699344, 2011347.	Early-habitation. Late-platform with metallic (?) slag.	Platform size = ca. 10 m N–S by 15.5 m E–W. Total area of sherd scatter is about 20 by 25 meters.	Earth and stone platform with three mounds. Two mounds at west end = ca. 3 m N–S by 4 m E–W. West-central mound = ca. 2.5 m diam.	Quachilco Mica (large jars, some w/strap handles). Coxcatlan gray (some slab feet). Coxcatlan brushed and coarse; Teotitlan incised.	None.	Late SM. Early VS, Middle VS.	Much burnt earth and "metallic slag"? Large rock piles/mounds are located to the east and west of the platform.
Tr-533	14Q, 0699343, 2011325.	Post-Classic platform.	Platform = ca. 10 m (N–S by 15 m E–W.	Earth and cobble construction.	Coxcatlan brushed and coarse; Teotitlan incised.	Few flakes of chert and obsidian.	Early VS, Middle VS.	Associated (?) rock piles.
Tr-534	14Q, 0699229, 2011291.	Rock wall exposed by erosion, in the west branch of Barranca Lencho Diego.	Wall = ca. 15 m long. Construction blocks = avg. 23.2 by 36.7 cm,	Cut/pecked shaped stone blocks of limestone (?) and gypsum.	Canoas/Coatepec white; Quachilco mica, gray; El Riego gray, black, marble-tempered; Coxcatlan brushed, gray; Texcoco Red.	Few chert flakes.	Middle SM, Late SM. Early PB. Early VS, and Middle VS.	Site largely buried by alluvium behind Tr-15.
Tr-535	14Q, 0699316, 2011263.	Post-Classic site with a platform.	Platform = ca. 8.8 m (NE–SW) by 22 m (NW–SE).	One long stone/ earth platform.	Coxcatlan brushed, gray.	Few chert flakes. Gray obsidian.	Early VS, Middle VS.	Area = ca. 194 m^2.
Tr-536	14Q, 0699189, 2011181.	Rock wall exposed by erosion, in the west branch of Barranca Lencho Diego.	Wall = ca. 25 m long. Construction blocks = avg. 19.8 by 35.9 cm.	Cut/pecked shaped stone blocks of limestone (?) and gypsum.	Canoas/Coatepec white; Canoas Orange-brown; Quachilco Gray.	Few chert flakes.	Middle SM, Late SM.	Site largely buried by alluvium behind Tr-15.

Tr-537	14Q, 0699250, 2011167.	Scattered wall alignments, as well as a sherd and artifact scatter.	Site = ca. 40 m (N–S) by 30 m (E–W). Area = ca. 1,200 m^2.	Cobbles and boulders used in construction. Estimated two structures present	Canoas/Coatepec white, Quachilco brown, red; Coxcatlan brushed, gray.	Chert and obsidian flakes and blades—some w/ground platforms.	Middle SM, Late SM. Possible Early PB. Early VS.	Site largely buried by alluvium behind Tr-15.
Tr-538	14Q, 0699212, 2011113.	Habitation-Administration site.	Site = ca. 50 m (N–S) by 50 m (E–W). Mound = 8 m by 22 m and 90 cm high,	A conical mound of earth and stones, with a dense scatter of Formative Period sherds.	Canoas and Coatepec white; Canoas orange-brown; Rio Salado Coarse; and Quachilco gray.	Few chert and obsidian flakes.	Possible Ajalpan. Early SM, Middle SM, Late SM.	About 90 m north of Tr-15. Probably not part of Tr-15 (Mac Neish et al. 1972: 391). Largely buried behind Tr-15.
Eastern Periphery								
Tr-451	14Q, 0699406, 2010829. MacNeish, Peterson, and Neely 1972, Spencer 1979, Woodbury and Neely 1972.	Habitation-Administration site.	Site = ca. 40 m (E–W) by 65 m (N–S). House = ca. 6 m (E–W) by 15 m (N–S).	Modified natural rise w/one stone-foundation house, a patio, and a stairway.	Canoas white, orange-brown; Quachilco gray; Coxcatlan brushed, gray; Texcoco B/R.	Few chert flakes, many obsidian flakes and blades.	Possible Early SM. Middle SM, Late SM. Early VS, Middle VS.	Site w/looted Late SM (?) tomb. Cut/pecked construction blocks. Probably associated with Tr-15. See Spencer 1979: fig. 2.10.
Tr-452	14Q, 0699410, 2010902. MacNeish, Peterson, and Neely 1972, Spencer 1979, Woodbury and Neely 1972.	Habitation-Administration site.	Site = ca. 30 m (E–W) by 110 m (N–S).	Five to 7 houses w/ stone foundations. Two are atop mounds with stairways.	Canoas/Coatepec white; Quachilco gray; Coxcatlan brushed *(fondo sellados, ollas)*.	Few chert flakes, many obsidian flakes and blades.	Middle SM, Late SM. Early VS.	Terraced talus-slope site, covered by dense *Acompe* cactus. One mound is higher than the other. See Spencer 1979: fig. 2.6.
Tr-539	14Q, 0699501, 2011087.	Small dam, seen in arroyo profile.	About 1 m high by 2 m wide in cross-section.	Unmodified cobbles and boulders.	None.	None.	Not determined.	Located southeast of Cerro La Isla and northeast of Tr-15..
Tr-540	14Q, 0699486, 2011008.	Small structure and ceramic scatter.	Site = ca. 4 m N–S by 8 m E–W. Structure: 2 by 3m	Unmodified cobbles and boulders.	Coxcatlan brushed.	None.	Early VS.	Situated about 30 m southeast of INAH Datum #3.
Tr-541	14Q, 0699491, 2010984.	Possible wall or house foundation.	About 2.0 m (N–S) and one course high.	At least one structure indicated.	Coatepec white; Quachilco gray.	Few flakes of gray-black obsidian. Green schist celt.	Middle SM, Late SM.	Area of sherd scatter is about 20 by 20 m. (400 m^2).
Tr-542	14Q, 0699466, 2010945.	Small one-room (?) house on a terrace.	Structure: ca. 2 m N–S by 3 m E–W.	Construction of cut/pecked slabs.	Coxcatlan brushed ollas.	None.	Early VS.	Site largely buried by alluvium behind Tr-15.
Southern Periphery								
Tr-453	14Q, 0699376, 2010633 (at North edge of site). "Altar" at 14Q, 0699376, 2010633.	Large rock-shelter with many stone foundations, platform mounds, and one shaped gypsum 3 m by 4 m "altar."	Lower terrace = ca. 55 m (E–W) by 115 m N–S, upper terrace = ca. 48 m E–W by 67 m N–S. Total area = ca. 9,541 m^2.	Unmodified cobble/boulder and cut/pecked block construction. Some clay plaster seen.	Coatepec white; Quachilco brown and gray; Coxcatlan brushed, gray, red, red/orange; Teotitlan incised.	Many chert flakes, many obsidian flakes and blades. Manos and metates, and stone "hoes."	Late SM, Early VS, Middle VS. Possible Late VS.	Located at south end of Tr-15. Largest Post-Classic site found in the Barranca Lencho Diego.
Tr-543	14Q, 0699320, 2010668.	Habitation (?) or "lookout" site. A single small mound with a small structure on top.	Area of sherd scatter is about 20 m by 20 m. Mound = 10 m (E–W) by 12 m (N–S). Structure = 3 m (E–W) by 6 m (N–S).	Small structure atop a small platform mound. Construction of earth, gypsum and basalt blocks.	Canoas and Coatepec white; and one sherd of Coxcatlan brushed.	Few chert flakes.	Middle SM, Late SM. Possible Early VS.	Site overlooks the south end of the Purrón Dam (Tr-435) and its reservoir. Similar to Tr-545.

Tr-544	14Q, 0699215, 2010666 (at west end).	Arcuate earth and stone terrace wall.	About 1 m high and 30 m long.	Unmodified cobbles and boulders in earth matrix.	Canoas white, Orange-brown; El Riego Orange; Coxcatlan brushed.	None.	Middle SM, Late SM. Possible Early PB. Early VS.	Arcuate-shaped w/convex side facing down-slope. Possible slumping.
Tr-545	14Q, 0699074, 2010594. Woodbury and Neely 1972.	Habitation (?) or "lookout" site. A single small mound with a small structure on top.	Mound = ca. 10 m (E–W) by 12 m (N–S), and about 75 cm high. Structure atop mound = ca. 3 by 6 m.	Earth and gypsum slab construction.	Canoas and Coatepec white.	Few chert flakes.	Probable Early SM. Middle SM.	About 10 m above drainage and 50 m S–SW of SW corner of Purrón Dam. Similar to Tr-543.
Barranca floor downstream from Purrón Dam								
Tr-67	Near center = 14Q, 0698956, 2010752. MacNeish, Peterson, and Neely 1972, Spencer 1979, Woodbury and Neely 1972.	Between 25 and 27 houses and a few stone foundations on broad, stair-step like terraces.	Site = ca. 250 m (N–S) by 200 m (E–W). Total area = ca. 50,000 m^2.	Unmodified large cobbles and boulders.	Canoas/Coatpec white; Rio Salado gray; Qualchilco gray. Only a few Coxcatlan brushed.	Few chert and many obsidian flakes and blades. VS ground stone and metal slag (?).	Possible Early SM. Middle SM, Late SM. Early VS.	Possible agricultural fields and garden (?) plots between houses. VS site and metal work found near west toe of Purrón Dam. See Spencer 1979: fig. 2.7.
Tr-449	14Q, 0698992, 2010969. MacNeish, Peterson, and Neely 1972, Spencer 1979, Woodbury and Neely 1972.	Habitation-Administration site. Nine to 12 houses situated atop human-made terraces. Two houses have stone foundations.	Site = ca. 180 m (E–W) by 65 m (N–S). House terraces = avg. ca. 9 by 18 m. Total area of site = ca. 11,700 m^2.	Two stone-foundation houses found on one large residential terrace that is surrounded by about 7–10 smaller terraces, each probably with one house.	Canoas and Coatpec white; Rio Salado gray; Quachilco gray; Formative figurine and incense burner fragments.	Few chert and obsidian flakes and blades. Ground stone.	Early SM, Middle SM, possible Late SM.	Located about 8 m east of the Santa Maria Canal. Unmodified large cobbles and boulders used in the construction of the two houses. See Spencer 1979: fig. 2.4.
Tr-450	14Q, 0699044, 2010949. McNeish, Peterson, and Neely.1972, Spencer 1979, Woodbury and Neely 1972.	Single (?) large mound.	Site = ca. 20 m (N–S) by 40 m (E–W).	Unmodified cobble and shaped block masonry seen in the erosional profile of the mound.	Canoas white, heavy plain; Rio Salado Gray; Quachilco Gray.	Few chert flakes, many obsidian flakes and blades.	Middle SM, Late SM.	Possible "public" building associated with the Purrón Dam. See Spencer 1979: fig. 2.7.
Tr-546	14Q, 0699047, 2010865.	Two platforms, each with a structure atop.	Site = ca. 2500 m^2. Platforms = ca. 20 m (N–S) by 24 m (E–W) and 25 m (N–S) by 20 m (E–W). Structures = ca. 3 by 4 m and 3.5 by 4 m.	Post-Classic house made of cut/shaped blocks at center (?) atop both low platforms. Situated near NE end of Site Tr-67.	Canoas Orange-brown; Coatepec white; Quachilco gray; Coxcatlan brushed, gray, red/orange. One spindle whorl (unknown ceramic type).	Ground stone. Metallic slag (?) found at NE corner of structure atop north platform.	Middle SM, Late SM. Early VS, Middle VS.	SM sherds likely from site Tr-67. A small hand-held "hoe"-like tool and a "mattock"-like digging tool of a greenish-gray schist found on the north platform near adjacent canal Tr-547. See Spencer 1979: fig. 2.7.
Tr-547	14Q, 0699024, 2010923.	Two canals, early canal buried by large west (back-dirt) berm of later canal. Flow direction = SW.	Original canal ca. 2.7 m wide by ca. 1.2 m deep. Later canalmoved to east and about same size.	Masonry block wall borders east side/berm of early canal, channel not lined.	None.	None	Probable Early/ Middle SM. Late SM. Possibly also Early and Middle VS.	Re-excavated later canal borders west side of Post-Classic platforms of Site Tr-546, near NE end of Site Tr-67.
Tr-548	14Q, 0698993, 2010906.	Buried cobble/boulder-lined canal. Flow direction = SW.	Canal = ca. 3.1 m maximum width by ca. 1.4 m maximum depth.	Unmodified cobbles and boulders lining canal channel.	None.	None.	Possible Early SM. Probable Middle and Late SM.	Probably supplied water to Tr-67. Based on its location, it may be part of Santa Maria Canal (Tr-508).