



## ***How geology and topography influenced the Battle of Valverde (February 21, 1862)***

Daniel J. Koning

2022, pp. 413-423. <https://doi.org/10.56577/FFC-72.413>

*in:*

*Socorro Region III*, Koning, Daniel J.; Hobbs, Kevin J.; Phillips, Fred M.; Nelson, W. John; Cather, Steven M.; Jakle, Anne C.; Van Der Werff, Brittney, New Mexico Geological Society 72<sup>nd</sup> Annual Fall Field Conference Guidebook, 426 p. <https://doi.org/10.56577/FFC-72>

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# HOW GEOLOGY AND TOPOGRAPHY INFLUENCED THE BATTLE OF VALVERDE (FEBRUARY 21, 1862)

DANIEL J. KONING

New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, NM 87801; dan.koning@nmt.edu

**ABSTRACT**—Like all land battles, the geologic and topographic features present at the Battle of Valverde, a Civil War battle 40 km (25 mi) south of Socorro, influenced the battle narrative. Particularly important features were: (1) two different-aged basalt flows capping Mesa del Contadero and an extensive terrace surface, (2) loose eolian and alluvial sand southeast of Mesa del Contadero, and (3) river channels on the floodplain north of Mesa del Contadero. Mesa del Contadero, which owed its existence to the basalt that capped it, is a conspicuous landform that controlled the geometry of the Rio Grande floodplain and was a topographic obstacle that both partly shielded the Confederates and also partly blocked their path. The cliffs and ledges of the lower Jornada basalts to the south of the mesa, which cap a 12–15 m (40–50 ft) tall terrace, and the fact that the Union army controlled the one piece of non-basalt covered, sandy ground that allowed access to the river, prevented the Confederate army from obtaining water and resulted in them being severely dehydrated on the day of battle. This dehydration was compounded by the intense physical effort needed to pull wagons and artillery through loose, eolian and alluvial sand southeast of Mesa del Contadero. The intense need for water spurred them in a “do or die” charge toward Captain Alexander McRae’s battery, whose successful capture resulted in a battlefield victory. The active Rio Grande at the time flowed south immediately north of Mesa del Contadero, and 650 m (700 yd) to the east was a dry (abandoned) river channel. The active channel offered refuge for the Union army from Confederate bullets, but impeded reinforcements to defend McRae’s battery. The eastern, dried-up river channel offered essential protection for the Confederate troops and allowed them to muster “under cover” toward McRae’s battery before their desperate charge. Moreover, the desire to enfilade and deprive the Confederates of this protection motivated Colonel Canby to send more troops from the middle of his line to the advancing southern flank, so that when the Confederates charged toward McRae’s battery there were less Union men at hand to stop it.

## INTRODUCTION

The Battle of Valverde was the first of two major Civil War battles fought in what is now the state of New Mexico, the other being the Battle of Glorieta Pass. Up to that time, it was the largest amassment of armies in New Mexico (Nelson, 2020), and it is notable as the largest Civil War battle in the American Southwest. In the Fall of 1861, 3200 Texans joined the Confederate army and, under the command of General Henry Sibley, marched or rode from San Antonio, Texas, to Mesilla (across the Rio Grande from Las Cruces), which was then the Territory of New Mexico. In early February 1862, a 2500-man Confederate force (Nelson, 2020) proceeded north up the El Camino Real from Fort Thorn (located 65 km (40 mi) north of Las Cruces) with the goal of capturing New Mexico and then the Pikes Peak gold fields of Colorado (Taylor, 1995). This audacious campaign hinged on the assumption that the invading army could “live off of the land” by capturing food and other supplies from Union storehouses (Taylor, 1995) or bequeathed to them by the New Mexican population, most of whom would welcome the Confederates and quickly switch their allegiance to the conquering army (Sides, 2006).

Fort Craig was the first major target of the Confederates marching north from Fort Thorn. It was constructed in 1854 to protect travelers on the nearby El Camino Real, especially from raiding Apaches (<https://www.blm.gov/visit/fort-craig-historic-site>). There was sufficient intelligence on the Union side to be aware of the Confederate movements. Colonel Edward Canby, who was in charge of the fort, had a frantic month to prepare for the invasion, during which he reinforced the fort, was able to muster 3800 regular and volunteer forces (Taylor, 1995), and received a train of 70 wagons loaded with food, supplies, and ammunition (Sides, 2006). Fort Craig was of

utmost strategic importance to the Confederates: if captured, they would obtain much-needed victuals and munitions, and there would be no Union troops blocking their supply chain and communication line back to Mesilla.

On February 16, the northward-advancing Confederate army marched to within 0.8–1.3 km (0.5–0.8 mi) south of Fort Craig (Taylor, 1995). With only 2500 troops, the Texans could not assault the fort itself. General Sibley instead hoped to draw the Union forces out of the safety of the fort and into open ground, where the Confederates had a chance of defeating them. Colonel Canby did not take the bait and kept his men amassed alongside or safely within the fort’s earthen walls. The separation of the two armies was ~730 m (~800 yd). There was some skirmishes and “posturing” involving small-arms fire, which mortally wounded one man, but after a few hours the stalemate nature of the situation became apparent, and Sibley retreated 6 km (4 mi) back to the south (Taylor, 1995; Sides, 2006). There, during the next two days, hunkering down in an intense windstorm, Confederate officials hatched a plan to occupy a strategic ford west-southwest of the town of Valverde (Fig. 1), thereby forcing the Union army into open battle—the fruition of which resulted in the Battle of Valverde.

This paper discusses how geologic and topographic features east of the Rio Grande and in its floodplain influenced the Battle of Valverde, which occurred on February 21, 1862. First, I summarize the pertinent geologic features east of the river and at the Valverde battlefield. I then synthesize how these features played a role in the events leading up to the main battle during February 19–21. The geologic information comes from three geologic maps (Koning et al., 2020a, 2020b, 2021). Unless otherwise noted, the historical information is from Taylor (1995) and references therein.



## GEOLOGIC AND TOPOGRAPHIC FEATURES – A SUMMARY

Geomorphic features of the Rio Grande floodplain, Rio Grande terraces, and two lava flows played noteworthy roles in the February 19–21 events of this Civil War battle. I will list and describe these geologic features from youngest to oldest, beginning with the floodplain and ending with the basalt flow that caps Mesa del Contadero. Rising 90 m (300 ft) above the Rio Grande floodplain, Mesa del Contadero is a conspicuous landform located 4 km (2.7 mi) northeast of Fort Craig and immediately south-southwest of the battleground (Figs. 1, 2). Aside from this mesa, the landscape on either side of the floodplain consists of low-relief badlands dissected by numerous relatively small, ephemeral tributary drainages of the Rio Grande.



FIGURE 2. Photograph looking southwest at the floodplain immediately right (north) of the basalt-capped Mesa del Contadero. The floodplain north of the mesa hosted the main Battle of Valverde, which occurred 7 AM–5 PM on February 21, 1862. The dark burn scar in the floodplain was from the Tiffany Fire that occurred in the summer of 2017. Sandy slopes in the foreground are underlain by the axial-fluvial facies of the ancestral Rio Grande (Plio-Pleistocene).

### Floodplain

The Battle of Valverde was fought on the floodplain of the Rio Grande 8 km (5 mi) northeast of Fort Craig (Figs. 1, 2). Here, the floodplain is 3.5 km (2 mi) wide, but as the Rio Grande bends around the northwestern end of Mesa del Contadero it narrows to 1.3 km (0.8 mi; Fig. 1). Back in 1862, the floodplain would have looked much different than today. Instead of impregnable, dense thickets of tamarisk (an exotic species introduced in the 19<sup>th</sup> century that expanded rapidly in the study area after the 1929 flood; Phillips et al., 2011), early descriptions and drawings of the battlefield describe scattered groves of cottonwood trees and willows, some relatively dense, interspersed with grassy fields supporting scattered, sparse cottonwood trees (Taylor, 1995; Sides, 2006; Pittman, 2011).

Prior to flood control projects in the mid-1900s, the historical Rio Grande in the area near Fort Craig and Valverde ex-

hibited a low- to moderate-sinuosity channel about 100–300 m (300–1000 ft) wide (French and Penick, 1908; maps of battle operations in Taylor, 1995). The main channel shifted laterally across the floodplain, often during flooding events, via avulsion. During these avulsion events, breakouts from the main channel would produce a fan-shaped lobe of sand that would mostly be orientated in a downstream direction (e.g., avulsion lobe in 1946 aerial photograph of river near Valverde; Army Map Service, 1947; Happ, 1948, fig. 2 of Plate 1). Incision of a channel could occur on this same sand sheet during the waning flood stages (Happ, 1948, fig. 1 of Plate 2). Once deposited, winds could locally move the sand into linear dunes (Happ, 1948, fig. 2 of Plate 2).

At the time of the Battle of Valverde, the main channel of the Rio Grande was to the west, approximating where the channel was located in the early-middle 20<sup>th</sup> century (i.e., the stippled-pattern channel shown northeast of “San Marcial” on the USGS 7.5-minute topographic map of San Marcial). This “active channel” had an eastern bank of sufficient height to screen Union soldiers from bullets, probably similar to the depth of the channel observed today near the abandoned town of Valverde (Fig. 3). At the time of the battle, two fords could be used to cross the river with wagons (Fig. 1), with the lower (southern) one being the most used at the time (Pittman, 2011). Presumably, these fords were places where the banks were low and the water shallower, allowing horses and wagons to cross. Away from the fords, the depth of water in the main channel on February 21, prior to snowmelt-fed spring runoff, was described as chest-high (Alonzo F. Ickis Diary, Feb. 21, 1862). About 700 yd to the east of the active channel was an abandoned, dry channel (Fig. 1; Taylor, 1995, based on Canby’s after action report), also deep enough to provide protection against bullets (probably >1 m), that was orientated northeast-southwest (likely comparable with the modern Rio Grande channel; Fig. 3). This abandoned channel played a key role in the battle.



FIGURE 3. Modern Rio Grande channel at the north end of the Valverde battlefield. The channel is about 1.0–1.5 m (3–4 ft) deep. Larger trees are mostly cottonwoods (with the ones to the left being burned by the Tiffany Fire). The shrubs immediately next to the water are tamarisks, which were probably not present at the battle scene because it occurred before this species was used extensively across New Mexico to control erosion.

## Terrace Landforms and Deposits

A terrace is a bench-like landform created during a time of relative base-level stability of a river, during which time the river is able to either carve out a relatively wide floodplain or there is sufficient aggradation to form a relatively wide valley floor. Subsequent incision of the river and its surrounding tributaries then convert what was formerly a valley floor into a topographically high bench. Older terraces (e.g., Pleistocene terraces) tend to be best preserved if they have gravelly sediment near their surfaces. If sand or finer sediment comprises the exposed terrace deposit, then erosion tends to degrade the terrace and often the bench-like surface is not preserved.

Along the Rio Grande near Fort Craig are four thick terrace deposits of middle to late Pleistocene age collectively called the San Marcial formation (Koning et al., 2021). For a given terrace level, fluvial main-stem terraces commonly grade laterally into thick alluvial fan deposits deposited by side streams. A terrace of particular importance is the lower of this set of four terraces, which will be referred to as the “Fort Craig terrace.” Fort Craig was constructed on this terrace at the mouth of Milligan Gulch, where the terrace fill is 9–10 m (30–35 ft) thick and composed of volcanic-derived sandy gravel deposited on an alluvial fan. The terrace height is 12–15 m (40–50 ft) above the Rio Grande floodplain. Fort Craig was built on the eastern end of this alluvial fan terrace, a position that offered a good view up and down the floodplain and also across the river, where the El Camino Real descended onto the floodplain just south of Mesa del Contadero.

Downriver, the Fort Craig terrace is mapped east of the Rio Grande (Fig. 1), where it is underlain by 11–12 m (35–40 ft) thick Rio Grande sand and minor rounded-subrounded gravel. Here, it is a few km (1–2 mi) wide and extends from near Fort Craig southwards 17 km (10 mi) to the northern end of the Fra Cristobal Mountains. Most of this fluvial terrace east of the Rio Grande is capped by a 2–3 m thick basalt flow, which is discussed below.

Immediately east and southeast of the main battle site are thick (up to 18 m, 60 ft) Pleistocene alluvial deposits composed of brownish, weakly consolidated sand with minor gravelly sand. These were deposited during a time of valley-wide aggradation that formed thick fill-terraces on the west side of the valley, correlative to the Bowling Green and/or Matanza formations in Socorro (Sion et al., 2020). The older alluvial fan deposits east of the battle site erode readily, and flat-topped surfaces are not preserved. Side arroyos cut relatively deeply into these older fan deposits before debouching onto the floodplain.

### Lava Flows and High Mesas

A  $78.1 \pm 3.2$  ka basalt (age from Sion et al., 2020) flowed onto the Fort Craig terrace surface east of the Rio Grande (Fig. 1). This extensive basalt is 1–8 m thick and was sourced from a volcano located 17 km (10 mi) southeast of Fort Craig. Being part of the Jornada del Muerto volcanic field, I will refer to this basalt as the “Jornada basalt.” The basalt served as a protective cap on what otherwise would have been easily erod-

ible, terrace-fill sand. The geomorphic surface on this basalt is rough, characterized by sharp, meter-scale ridges and depressions. However, eolian (wind) activity has draped a sand sheet on much of the flow, especially where the basalt caps the Fort Craig terrace near the Rio Grande, with the resulting surface being a hodgepodge of rough basalt interspersed with patches of sand (Fig. 1, unit Qbe; Koning et al., 2020b).

An older volcanic flow ( $818.3 \pm 10.6$  ka per Sion et al., 2020) caps Mesa del Contadero. This flow consists of a 3–7 m thick basalt that emanated from a small cinder cone at the north-center part of the mesa. Because of its relatively old age, the basalt surface has mostly been covered by 1–2 m (3–6 ft) of very fine- to medium-grained sand of eolian (wind-blown) origin.

The top of the Mesa del Contadero flow is just 3–5 m (10–15 ft) higher than an extensive, high-level geomorphic surface east of the Rio Grande. This surface projects to the base of the basalt flow and represents the culmination of ancestral Rio Grande sedimentation (see below). This high-level surface appears to be continuous with the surface of the Jornada del Muerto Basin to the south and correlates to the Las Cañas geomorphic surface near Socorro (Sion et al., 2020). Where exposed, this geomorphic surface exhibits a >1 m (>3 ft) thick soil whose old age has allowed development of a stage III+ to IV calcic horizon (Koning et al., this volume). However, north of the Jornada del Muerto basalt flows, this soil is mostly buried by an eolian sand sheet (Qe/cs, eolian sand over Las Cañas surface) 1–3 m thick, locally featuring subdued linear dunes and minor transverse dunes.

### Axial-fluvial Facies of the Ancestral Rio Grande

Underlying the basalt flows east of the Rio Grande is >120 m (>400 ft) of white, weakly consolidated, quartz-rich sand laid down by the Rio Grande during the Pliocene and early Pleistocene (6 to 1 Ma). This sand abuts the terrace deposits east of the main battlefield site. The lack of consolidation and cementation results in an erodible deposit that readily generates sandy colluvium and alluvium. This sand is referred to as the axial-fluvial facies of the ancestral Rio Grande. Stratigraphically, this sand extends laterally into both the Sierra Ladrones and Palomas formations, whose boundary happens to lie near San Marcial (cf. Koning et al., 2020a, 2021). For the sake of simplicity, the axial-fluvial facies will be consistently labeled as part of the Palomas Formation in this paper (QTpa).

## BATTLE NARRATIVE (FEBRUARY 19–21, 1862)

### Bypass of Confederate Army around Fort Craig

After their first attempt at battle on February 16, the Confederates retreated 6 km (4 mi) down the river to camp near a river crossing to the small town of Paraje de Fra Cristobal (Taylor, 1995, map of operations). They hunkered down there when an intense windstorm struck during February 17–18. It was during this time that General Sibley held a council with his top officers, and they decided it was futile to mount a



FIGURE 4. Photograph of the basalt-capped Fort Craig terrace. The basalts flowed down from the Jornada del Muerto volcano at  $78.1 \pm 3.2$  ka (Sion et al., 2020). The erosional resistance of the hard basalts largely preserved the terrace from further erosion. On the skyline, to the left, the lighter-colored sediment is eolian sand that has been deposited on top of much of the basalt after 78 ka. Photo taken 2.8 km (1.8 mi) southwest of the old town of Paraje de Fra Cristobal. The top of the basalt is 10 m (30 ft) above the adjoining floodplain supporting cottonwood tree growth.

full-frontal attack on the fort. Their only chance was to engage the Union army well away from the fort's guns and walls. But where and how? It was the second-in-command officer, Colonel Tom Green, who hatched the idea of engaging the Union troops by occupying a critical river ford 4 km (2.5 mi) southwest of the town of Valverde (Sides, 2006). To do that, they needed to bypass Fort Craig by heading for the east side of Mesa del Contadero (Fig. 1). The Confederates fortunately had a man named George Frazer who travelled the El Camino Real frequently as a dispatch rider and wagon master for the U.S. Army in the territory, and he knew the land better than most and could lead them there (Pittman, 2011; Nelson, 2020). If the Confederates could occupy the ford, they would cut off all wagon supplies to Fort Craig and effectively lay siege to the fort. More importantly, Colonel Canby would realize the grave consequences of such a siege and would thus engage the Confederates in open battle, a scenario where the Confederates thought they had an advantage. If they could decisively defeat the Union army, Sibley's force could seize the considerable supplies there and obtain a relatively secure supply and communication line back to La Mesilla.

Due to the cliffs formed by the Jornada basalt capping the Fort Craig terrace (Fig. 4), the Confederate army had to travel south a few miles to the town of Paraje de Fra Cristobal. This town of ~200 (per the 1860 U.S. Census; Marshall and Walt, 1984, table 12.4) was situated on a low terrace east of the Rio Grande. The surface of this terrace was inset ~5 m (14–16 ft) below the older Fort Craig terrace surface and stood 5–6 m (15–20 ft) above the adjoining floodplain (French and Penick, 1908). Near the townsite, the Jornada basalts did not extend to the eastern riser (bluff) of the Fort Craig terrace, and so the sandy terrace eroded to form a wagon-accessible slope from the Fort Craig surface down to the floodplain (Koning et al.,

2020b). From the village, the Confederate army could follow the El Camino Real to the north toward Mesa del Contadero and then on to Valverde, a distance of 23 waterless kilometers (14 mi). On this portion of the road, one could avoid the worst of the rough basaltic outcroppings by keeping to the relatively wide patches of eolian sand.

The trail descended off of the north end of the basalt-capped terrace 2 km (1.2 mi) south of Mesa del Contadero (Fig. 1), continuing northwards toward a place called Contadero. Here, travelers along the El Camino Real would have been able to obtain drinking water from the Rio Grande just south of Mesa del Contadero. South of there, the Jornada basalt formed >2 m (>6 ft) tall ledges (e.g., Fig. 4) and access to the river was difficult. But 2 km (1.2 mi) south of Mesa del Contadero the basalt ended, allowing erosion of sandy Quaternary deposits and ready access to the Rio Grande.

Colonel Canby sent out soldiers to occupy the northernmost part of the Fort Craig terrace (Fig. 5) to prevent the Confederates from setting up artillery on basalt-capped bluffs that were only 1.6 km (1 mi) away from Fort Craig. Sticking to their plan, and wishing to avoid both this force and being in range of the fort's cannons, the Confederates left the eastern El Camino Real trail and veered northeast (Fig. 1). At first, this route would have been on the eolian-draped top of the Jornada basalt, but after ~5 km (3 mi) they would have come to the eastern edge of a kilometer-scale, northward protruding lobe of basalt (Figs. 1, 6). Beyond the basalt, the Confederates would have dropped onto loose, Holocene-age eolian and alluvial sands on the axial-fluvial facies of the ancestral Rio Grande (Figs. 1, 6). After crossing a north-trending topographic low paralleling the eastern edge of the basalt (Fig. 1, unit Qea), the Confederate army traveled up a northeast-trending arroyo filled with loose sand reworked from eolian deposits and the axial-fluvial facies (Fig. 1). The loose sand proved to be particularly hard going for the thirsty soldiers and half-starved horses. The soldiers had to help drag the guns and wagons through particularly sandy stretches.

In the mid-afternoon, Canby decided to "take the fight" to Sibley by sending several hundred men from Fort Craig to confront the struggling Confederate army. Seeing the oncoming Union army, Sibley placed about half his men in a line of battle on the ridgeline (Fig. 1), while the teamsters and soldiers continued to inch the wagons up through the deep arroyo sand. Once the federals were within range, the Confederates fired at them with six- and twelve-pound guns. This firing scared Colonel Miguel Pino's regiment of New Mexico volunteers, who panicked and fled back to the fort, carrying other units with them (see Fig. 7 for ranking of noteworthy officers on either side of the conflict). These fleeing troops could not be rallied, and so Canby reluctantly retreated back to the fort. However, Canby placed enough Union troops to hold the northern tip of the basalt and the low ground between the basalt and Mesa del Contadero. Thus, the Confederate troops were denied access to the river, and on the night of February 21 they set up a string of waterless camps east of Mesa del Contadero, many likely on the eolian sand-capped Las Cañas surface.

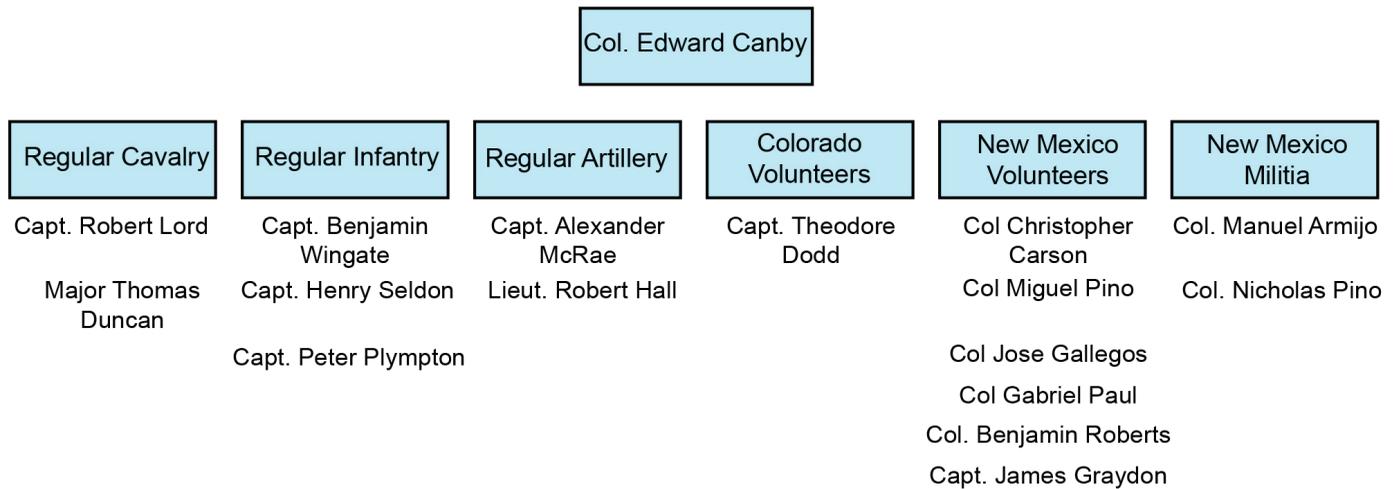


FIGURE 5. View looking northwest from the approximate route taken by the Confederate troops, where they crossed geologic map unit Qea (Fig. 1). Mesa del Contadero is on the right, and the southern Magdalena Mountains are in the far distance. The black arrow shows Fort Craig, and the white arrow shows the northern edge of the basalt-capped Fort Craig terrace. Gray arrows depict the northeastern margin of the Jornada basalt, which parallels the railroad track to the left. The northern part of the Fort Craig terrace east of the Rio Grande was occupied by Union troops (Fig. 1). These troops plus the proximity of Fort Craig (and its artillery) prevented the Confederate army from obtaining water from the river where the El Camino Real trail met the south edge of Mesa del Contadero.



FIGURE 6. View to the south of the dark Jornada basalt flow (background) and poorly exposed, axial-fluvial sand of the ancestral Rio Grande (QTpa, foreground). The white arrows denote the northeastern margin of the basalt flow, which forms a small, meter-scale escarpment. The approximate location of the town of Paraje de Fra Cristobal is shown by the black arrow. On February 20, 1862, the Confederates marched north and then northeast from this town on the Jornada basalt flow, and then crossed off of its northeastern margin into weakly consolidated—loose sand filling arroyo bottoms—such as the sand north of the white arrows. This sand is derived from erosion of the axial-fluvial facies and from wind deposition. The loose sand here notably slowed progress of the Confederate troops.

### Union Order of Battle



### Confederate Order of Battle

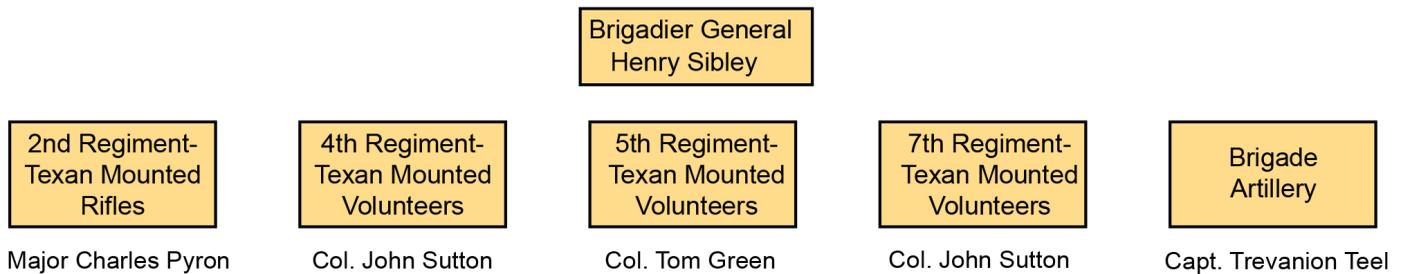


FIGURE 7. Partial list of Union and Confederate officers engaged in the Battle of Valverde, compiled using Taylor (1995).

#### The Bloody Battle

Cold weather with intermittent snow flurries characterized the weather on the day of the main battle, February 21. Major Charles Pyron, being the farthest north of the Confederate troops, left before sunrise that day with 180 men to reach the river near the ford. He arrived there between 7:00 and 7:30 AM, making his way to the upper ford hidden in a grove of cottonwoods (Fig. 8). They got their drink, but were soon discovered by an advance guard of Union troops. A firefight ensued, and Pyron retreated back to the southern end of the abandoned channel ~0.6 km (700 yd) east of the active river channel and sent a courier back southward asking the other Confederate units to hurry to his aid.

The trailing Confederate regiments heeded the call and hurried northward to the wide floodplain east of the two fords. They probably got there by descending off the Las Cañas geomorphic surface into the canyon draining northwest from the saddle between Mesa del Contadero and this geomorphic surface near Mesa Camp (Fig. 1, Qe/cs). It is conceivable they could have descended down one of the many parallel canyons to the east of this one. But whatever canyon they chose, they likely stayed in it, because going up and over the intervening ridges would have been arduous due to the loose, sandy surface overlying the axial-fluvial facies of the ancestral Rio Grande.

The main battle was fought between the aforementioned western river channel and the 5–20 m (15–60 ft) tall bluffs underlain by older alluvial fan deposits immediately east of the floodplain (Figs. 1, 8). At the battlefield, the floodplain was capped by a sand sheet that extended 1.5 km (1 mi) north-south and was up to 0.8 km (0.5 mi) wide (Pittman, 2011). Incised into this sand sheet was an abandoned, dry river channel bed located ~0.6 km (700 yd) east of the active river channel. This sand sheet probably represented an avulsion-related splay formed during a 19<sup>th</sup> century flood event, which later was incised by the main river later in that particular flood or in subsequent floods. A similar, although much-later, aggradation-incision scenario was documented in the same area based on observations and measurements made between 1937 and 1941 (Happ, 1948). At the time of the battle, this eastern river channel was abandoned and dry due to an avulsion event that changed the river’s course to the west. Two dense cottonwood groves were present, one near the upper ford and one just north of the north end of Mesa del Contadero (Figs. 1, 8).

On this floodplain, the fighting of the main battle lasted the remainder of the day. The depiction of troops and their respective advances and retreats on a map of the battlefield is shown on Figure 8. The eastern, dry (abandoned) river channel proved to be a key feature in the battle. Its depth allowed Confederate troops protection from the Union army’s bullets and also

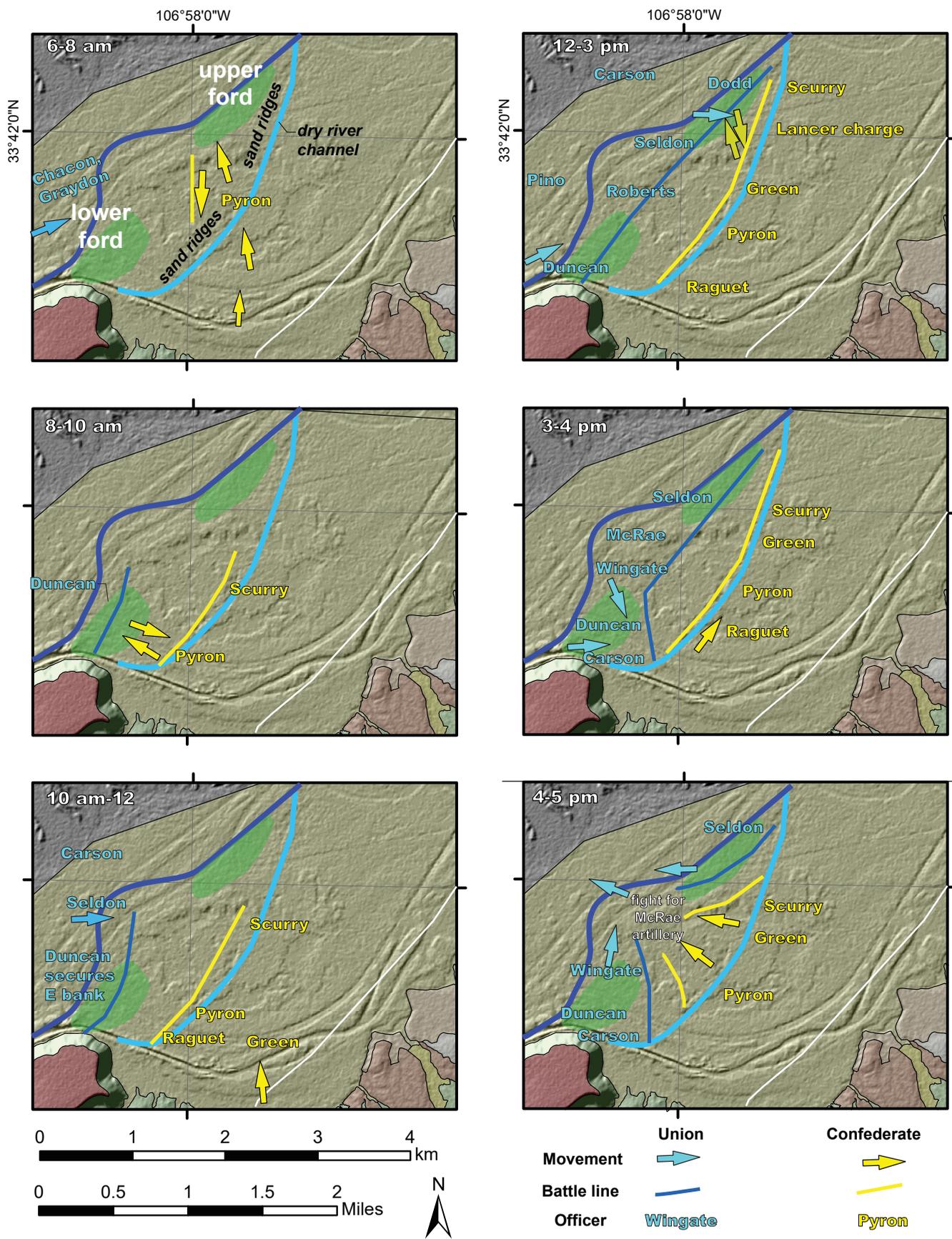


FIGURE 8. Six time-series map panels of the battlefield events near Valverde Ford, February 21, 1862. Locations are inferred using descriptions and maps of Taylor (1995). Symbology of topographic and geologic features follows that in Figure 1. A key feature in the battle was the dry river channel (light blue line) located 0.6 km (700 yd) east of the active channel.

concealed their north-south movements. The south end of this channel was close to the northern end of the mesa, and this allowed the Confederates to shoot any Union sharpshooters who tried to scale the northern slopes of Mesa del Contadero (Pittman, 2011). In the mid-morning, the Confederates issued forth from the southern end of the channel three times to attack the southern cottonwood grove, but the Union's ably manned southern (right) flank, aided by 24-pound howitzers, sent the Confederates scurrying each time back to the channel (Pittman, 2011). The active Rio Grande channel, meanwhile, offered the Union army protection from Confederate bullets.

By noon, all forces were assembled on the battlefield, including Colonel Canby on his favorite horse, Old Chas. Conspicuously missing was General Sibley, who was incapacitated in his "ambulance wagon" back at the camp of the previous night, likely due to drunkenness. His second-in-command, Colonel Tom Green, was squarely in charge of the Confederates on the battlefield. But the Confederates were getting the worse of the fight. Reinforcements continued to beef up the southern arm of the Union army and also were sent across the river near the upper ford, where they pushed the Confederates back toward the eastern, dry channel and bluffs. However, the Confederates on the north end of the eastern channel, commanded by Colonel William Scurry, were well protected by the channel and a "sand ridge" alongside of it (perhaps an eolian sand dune or natural levee) and were able to hold off the Union advance.

At 2:30–3:00 PM, a particularly ghastly episode of butchery occurred. A company of Colorado volunteers, commanded by Theodore Dodd, were on the Union's north flank advancing toward the north end of the eastern, dry channel. But their progress was interrupted by a surprise charge of 50 Confederate horsemen (Nelson, 2020), armed with 9 ft long lances tipped with metal blades, galloping toward them. Dodd, a West Point graduate who had received specific training on how to respond to such a scenario, formed his men into a square whose perimeter was comprised of two rows of soldiers, with men in the front line kneeling down. These men held their fire until the galloping lancers were within ~40 m (~40 yd) and then fired a barrage of bullets in two successive volleys (Nelson, 2020). Twenty of the charging Confederates were killed and most of the horses shot in what was the last use of lances in U.S. battle history.

At mid-afternoon, things were looking good for the Union army. The lancer charge met defeat, and the Union's two batteries were pulled through the river. McRae's battery, near the north-center of the field of battle, was moved closer to the Rebel lines but into a more exposed area. It was surrounded by 300 regular and volunteer forces. The other battery was sent to the Union army's southern flank.

It was at this point, however, that events took a dramatic turn, in large part due to the desire of the Union army to deprive the Confederates of their secured position in the southern part of the eastern, dry channel. The southern arm of the Union army, under Major Thomas Duncan and Christopher ("Kit") Carson, was doing impressively well and slowly advancing eastward toward this channel. It was hoped that the southern

battery could be set up at a position east of the north end of the mesa, where it would be able to fire northeastward down the length of the channel (called an enfilade). Colonel Canby sent Captain Benjamin Wingate's troops to the south to aid the effort, but this left a ~700 m (800 yd) gap in the middle of his line.

Colonel Green, meanwhile, was in a desperate situation. He was clearly losing the fight, and with no water it was too long of a distance to retreat back to Paraje. It came to the point of either fight or surrender, and he chose to fight. Noting the gap in the middle line (Nelson, 2020), Colonel Green ordered his available men to charge and capture McRae's battery. The depth of the eastern, dry channel allowed him to secretly muster 750 men at a point closest to the battery. From there, the Confederates made an audacious "do or die" charge, coming in three waves, separated by ~20 m (~20 yd), led by Confederate officers. Many were killed, but nevertheless they kept running and soon reached McRae's battery. The sight of all these charging Confederate soldiers sent all of the New Mexico volunteers and many of the regulars scurrying back west across the Rio Grande. The stout-hearted Union soldiers who remained at McRae's battery engaged in bitter hand-to-hand fighting. At close range, the Confederates found that their shot-guns gave them a distinct advantage. Nearly half of the men of McRae's battery died, including Captain McRae, and casualties were high among the regular infantry who stayed to defend the guns. One Union artilleryman, sensing imminent defeat, yelled "Victory or Death" and fired a shot into a nearby magazine of ammunition; the resulting explosion killed him and several nearby Confederates (Alonzo Ferdinand Ickis Diary, February 21, 1862). Soon, however, the Confederates were firmly in control of McRae's guns and turned these guns on the fleeing Union soldiers wading across the river. This gunfire and the difficulties of crossing the river notably weakened the resolve of soldiers mustered on the western shore of the river to help McRae. The southern arm of the Union army, reveling in their success at turning the Confederate's southern flank, got word of what was going on at McRae's battery. They attempted a counterattack, led by Captain Wingate, but were thwarted and the captain mortally wounded.

Seeing this failed counterattack, the slaughter of the Union forces by the Confederates as the Yankees attempted to cross the Rio Grande, and with the Confederate position at McRae's battery being continually reinforced, Colonel Canby made the decision to retreat using the road back to the fort and ask for a truce. This road was probably well traveled and mostly traversed the Rio Grande floodplain, so this retreat could occur in a much quicker manner than the arduous route the Confederate army had to take the preceding day. Having a 100–300 m wide river between the Union army and the Confederates aided the retreat, since the Union rearguard could have inflicted heavy losses on the Confederate army if the latter attempted to cross the river. Canby's decision to retreat with the majority of his force still battleworthy effectively denied Sibley of his ultimate prize: Fort Craig with its all-important food, blankets, and munitions. The Confederates won the battle but were down 229 men (71 killed or mortally wounded, 157 wounded, and

1 prisoner) and had to trudge northwards with a well-manned fort cutting off their rear supply lines. The Union army suffered 475 casualties, with 111 dead, 160 wounded, and 204 missing—about 17% of the approximately 2800 troops at the battlefield (Taylor, 1995).

### **Role of Battle in Civil War**

Although admittedly a long shot, if Sibley had succeeded in his plan to conquer the Colorado (and perhaps California) gold fields, it would have been a crippling blow to Lincoln's use of gold bullion to finance the Union war cause (Taylor, 1995). Even though the Confederates clearly won the battle and suffered fewer casualties, the failure of capturing the supplies at Fort Craig undoubtedly hobbled their New Mexico campaign. Free to operate in Fort Craig, Colonel Canby immediately after the battle was able to send out Major James Donaldson and 280 men to destroy all the food stores in Albuquerque (Pittman, 2011), compounding the problem of feeding 2500 Confederate troops in a state where most of the population lived in poverty and didn't have much "to share" with the invading army. However, the capture of supplies at Cubero by a four-man army of New Mexicans sympathetic to the Confederates, led by Dr. Finis Kavanaugh, temporarily alleviated this food problem (Pittman, 2011). The news of the Union's loss at the Battle of Valverde had the effect of spurring the 950-strong Colorado volunteers to march even faster (Sides, 2006). Incredibly, these men covered 400 miles in only 13 days, much of it in snow and severe weather (in a single 36 hour stretch they covered 92 miles), allowing them to engage Pyron and Scurry's men at the Battle of Glorieta Pass. There, one particularly colorful Colorado volunteer, Major John Chivington, was able to lead a contingent of men around the scene of fighting and destroy the Confederate supply train. Even though the Confederates again achieved the upper hand on the battlefield at Glorieta, the harsh reality of insufficient food quickly became apparent. This lack of food, a formidable fort ahead yet to be conquered (Fort Union), and Colonel Canby leading a force northward to combine with the Colorado volunteer force must have played heavily in Sibley's decision to retreat, effectively ending the Confederate threat to the Union's bullion supply.

### **Legacy of Battle in New Mexico Geology**

Not only did geology and topography play a role in influencing the Battle of Valverde, but the battle, in turn, influenced New Mexico geology, particularly its stratigraphic nomenclature. After the battle, two fallen Union captains were posthumously honored by having their names affixed to two forts. Fort Fauntleroy, near present-day Gallup, was renamed Fort Wingate for Captain Benjamin Wingate. A newly constructed fort 13 km northeast of Truth or Consequences in the southern Fra Cristobal Mountains, named Fort McRae for the man who valiantly died defending his battery, protected a crucial spring in Cañon de Muerto and the middle reach of the El Camino Real. These two forts, in turn, were the namesakes for two well-known stratigraphic units: (1) the Late Cretaceous, cera-

topian-rich, clastic deposit called the McRae Formation, and (2) the Early Jurassic eolinite known as the Wingate Sandstone.

### **The Battlefield as it Looks Today**

As of the time of writing this paper, access to the main battlefield is provided by a dirt road that leads east from the low-flow conveyance channel near San Marcial. This road passes 0.5 km (0.3 mi) north of Mesa del Contadero and through the battlefield. Today, the battlefield is overgrown with thick tamarisk trees, so walking around the battlefield is difficult. Also, this particular area on the Rio Grande has experienced 2–3 meters (several feet) or more of aggradation (sand, silt, clay) since 1882 (aggradation rates and discussion in Happ, 1948), so the battlefield is effectively buried.

### **SYNOPSIS**

Probably the two most important geologic features influencing the Battle of Valverde were the basalt flows capping the Fort Craig surface and Mesa del Contadero, as well as the eastern, abandoned (dry) river channel. The ledges formed by the Jornada basalts deprived the Confederate army of easy access to water on their northward "bypass" march, as did the towering Mesa del Contadero that owed its existence to its cap of 818 ka basalt. The fact that the Union army could occupy the northern prong of the Jornada basalt further ensured that the Confederates could not reach the river immediately south of Mesa del Contadero. Although some Confederates were able to sneak down to the river on the night of February 20 (Thompson, 2001, p. 46, 52), by and large they and their animals were severely dehydrated during the battle. The fact that they could not retreat back to Paraje, due to the 23 km long journey without water, may have been a factor in Green's decision to fight on rather than retreat. Furthermore, the Confederate's intense desire for a drink of water could have been a major driver of their desperate charge onto McRae's battery. According to Sides (2006, p. 361), "Some Texans later admitted that much of their 'maddened determination' was born of their desperation for water—many were dying of thirst and were thus willing to risk anything to reach the river."

The eastern, dried-up river channel was a key element in the battle itself, as noted by Taylor (1995). It offered essential protection for the Confederate troops and allowed them to muster "under cover" toward McRae's battery before their desperate charge. Moreover, the desire to enfilade and deprive the Confederates of this protection motivated Colonel Canby to send more troops from the middle of his line to the advancing southern flank, so that when the Confederates charged toward McRae's battery there were fewer Union men at hand to stop them. Like all land battles, the geologic and topographic features at the Battle of Valverde were key components of the battleground framework that shaped the battle narrative.

## ACKNOWLEDGMENTS

I thank Armendaris Ranch for access to their land during my geologic mapping efforts of 2018–2020. I also am grateful for the helpful reviews of Talon Newton, Fred Phillips, and Paul Harden.

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Graveyard at Valverde Townsite