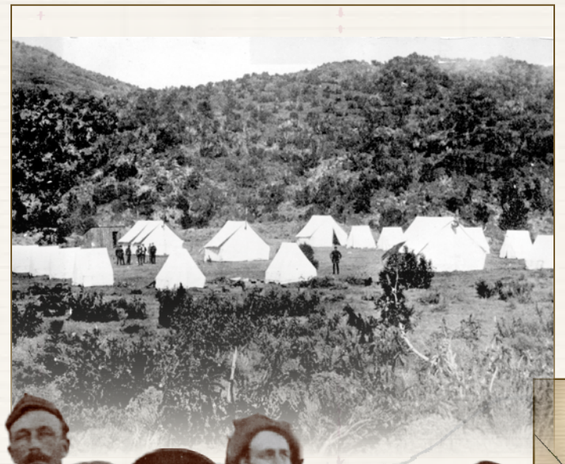
History of the

Rio Grande at Embudo Streamgage

Why a Remote Outpost Like Embudo?

Congressional funding for the Irrigation Survey (an early branch of the USGS) was intended for the arid West, meaning all land west of the 100th meridian. A component of the planned irrigation survey was an inventory of all streamflow in order to evaluate the irrigation potential to nearby land areas. The first step in this inventory was to train hydrographers and develop equipment and techniques for measuring streamflow in an arid environment. Getting the program underway as soon as possible after Congressional funding in October 1888 meant that weather was a consideration. Most northern streams would soon be frozen, leaving the southwest as the only practical alternative. Embudo was located far enough south for the Rio Grande to have flowing water throughout the winter. In addition, railroad transportation connected directly with the Embudo site, expediting transport of personnel and equipment and providing access to outside resources. This access would become important in the development and adaptation of equipment and techniques that would become the foundation of USGS streamgaging methods.



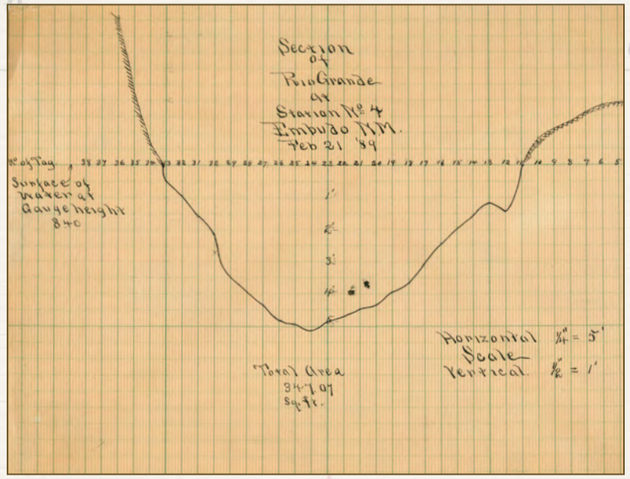
"A small body of men of good education and high general intelligence"

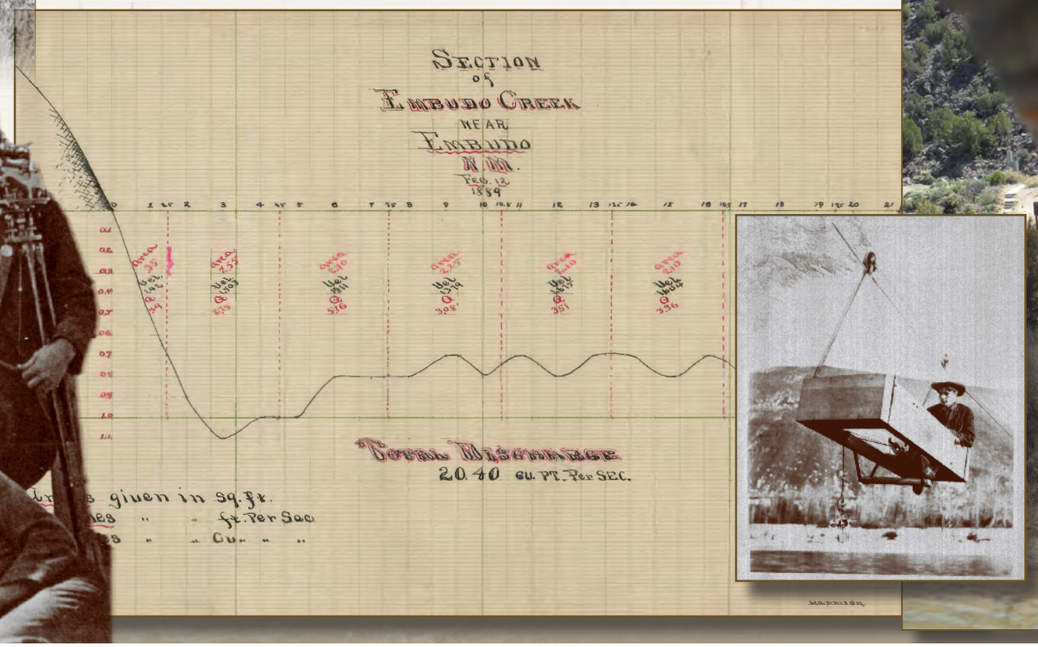
"Men of Good Education and High General Intelligence"

These are the words C.E. Dutton, head of the Hydrographic Branch of the Hydraulic Survey, a division of what was then the Irrigation Survey, used to describe the trainees who became the first group of USGS hydrographers. Many of them were newly graduated engineers from colleges in the East, and only one had prior experience in the West. Winter at Camp Embudo, at an elevation of over 5,800 feet, was cold. Most of the men abandoned their cots to sleep in shallow trenches dug in the dirt floors of their Army tents, and a few excavated a cave into a nearby hill. Training continued through April, after which the men dispersed throughout the West. Techniques and equipment developed at Camp Embudo became the foundation of the Irrigation Survey program and, later, of the USGS systematic streamgaging program. This photograph shows only part of the group.

Pioneers of the Craft

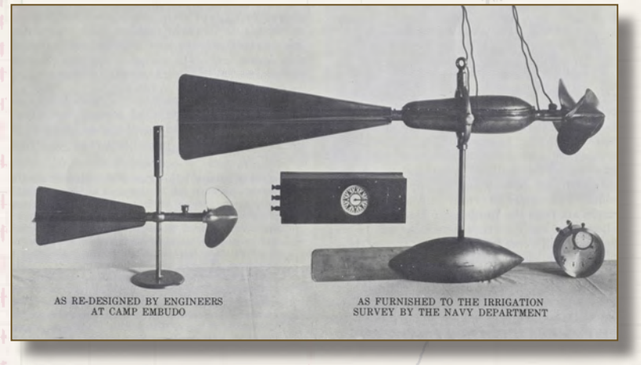
Embudo, the Spanish word for "funnel," describes the convergence of the San Juan Mountains and Culebra Range foothills that created a defined channel cross section for experimentation and refining of streamgaging equipment and techniques. After acquiring some experience, students were sent off to nearby streams to test their abilities to select suitable gaging sites, install streamgages, and make streamflow measurements. The hand-drawn cross sections below were constructed in making discharge measurements on the Rio Grande and Embudo Creek.





Refining the Tools

Adapting and improving equipment and techniques for use in the West were important activities at Camp Embudo. Improved methodologies were developed for the measurement of stream velocity, suspended sediment, and bedload, and for making weather observations. A device for measuring the velocity of flowing water, called a velocity or current meter, was furnished by the U.S. Navy. This meter was modified over successive trips to an instrument shop in Denver, Colorado, to better accommodate the shallow water and streamflow conditions of the Rio Grande at Embudo. Other types of rod-suspended meters were improved upon as well, and experiments with these meters refined techniques for measuring stream velocity, some of which are still in use today.



From U.S. Geological Survey Fact Sheet 2014–3034