

## Connecting Echoes

by Craig R. Dylan

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*Integrated equipment speeds surveying work for a new dock in downtown Napa.*



*Cinquini & Passarino Inc.'s James Brown, LSIT, and Erik Vonderscheer survey the Napa River for the Main Street boat dock.*

When California's City of Napa asked James M. Dickey, PLS, to provide a hydrographic survey of a relatively shallow section of the Napa River in January 2009, he knew the project would be challenging. Dickey, who is president of Cinquini & Passarino Inc., had done similar work in Sonoma County in old quarries near the Russian River, and he had also handled some hydrographic work for the Sonoma Development Center to determine the volume of a reservoir. The workflow on the Sonoma projects had been tedious, and he hoped to do better this time.

"On those jobs," Dickey explains, "we used an echo sounder to determine the depth, but we didn't have any way to integrate the depth and the horizontal location." So, one person in a small powerboat would hold a prism, while another person on the shore would take a shot with a total station. Then, after noting the depth from the echo sounder, the person on shore would enter that as the "rod height." The process worked, but the continuous manual data entry was time consuming and created numerous opportunities for entry errors.



*Cinquini & Passarino's GPS base station setup.*

The Napa River survey was commissioned to support design of the new Main Street boat dock. An existing dock at 4th Street was removed in late 2005 as part of an extensive Army Corps of Engineers flood control project that included construction of a floodwall and waterfront promenade in downtown Napa. "The old dock was made of wood and would not support the needs of the new Riverfront, but the new concrete dock will be larger and will allow increased boat access to downtown Napa," says

Mark A. Tomko, a senior civil engineer for the city. When complete (anticipated in late 2009), the dock is expected to be a popular destination for recreational craft, day-trippers and commercial services.

But to get the details right--quantities, placement of piles to support the dock, etc.--good topographic work was needed, and it had to be on the Army Corps of Engineers' vertical datum.

### Pushing the Envelope

Tomko walked the site with Dickey to set the project limits, which started on the banks around the proposed dock location and extended into the river and around the floodwall. Dickey used a Trimble S6 Total Station for the topographic work, but he wanted to try something different for the work in the river.

"I did some research online," Dickey explains, "and noticed that our Trimble TSC2 controller had a new routine that allowed it to be coupled with the Ohmex SonarMite." The Bluetooth-enabled SonarMite Echo Sounder works well in shallow water and with small boats. Dickey rented a SonarMite unit and used the Bluetooth capabilities to connect it and his company's Trimble R8 GPS receiver to the Trimble TSC2. Because it was Dickey's first use of this equipment combination, he used a rod to check depth in several locations. According to Dickey, the echo sounder "checked right on."

"No one around here had done anything like this before," Dickey says, "and even the people I rented the echo sounder from suggested [using software that] connects to GPS units and exports raw data. But I'm glad I stuck with this solution. For one thing, the Trimble routine automatically combined the antenna height, elevation and river depth from the echo sounder to give me the correct river bottom for the z value, and I still had access to the antenna height and water level elevation for checks.

"I also didn't have to wait for post processing to do site calibrations, and the exported data stream is in my preferred PENZ [point number, easting, northing, zenith] format and imported right into AutoCAD. I could have done this with a lead line or even a prism pole, but by using the sounder this way I was able to reduce my budgeted time for field work by 25 percent--and I saved office time, as well, thanks to the cleaner import."

Dickey considered using the total station rather than the Trimble R8 GPS receiver, but currently it's not an option to use the echo sounder with a total station. "Basically, version 12.42 of the Trimble TSC2 controller software includes a check box for using the depth sounder," he says. "Right now, this model of sounder works with our GPS receiver, so we took advantage of it." It was fortunate that the survey ended right at the bridge, he says. Otherwise, the GPS satellites may have been blocked and older methods would have had to be used.



*Brown and Vonderscheer survey in front of the new floodwalls constructed by the Army Corps of Engineers.*

### **Exceeding Expectations**

Once Dickey had verified the precision of the new measurement system and determined that latency wasn't an issue, he set crew members James Brown, LSIT, and Erik Vonderscheer to work. While one person guided the small powerboat back and forth across the area of interest, the other tended the echo

sounder, controller and GPS receiver unit. The Trimble R8 was set to continuous topo mode, and the echo sounder was set at a 2-hertz interval taking two readings every second. The echo sounder was clamped to one side of the boat and was positioned underwater; the receiver, which was on a pole, was mounted above the echo sounder.

"I was a little concerned about lag at first because there is a distinct grade break in this section of the river," Dickey says, "but manual checking always verified the readings we were getting." The controller actually collected two height measurements: the depth provided by the echo sounder, and the water's surface elevation, which functioned as a check. The two measurements were stored separately in the TSC2, and both were exported with a style sheet. Dickey found that even with water chop, the levels of accuracy in the echo sounder and GPS receiver were high enough that river bottom measurements were "within a tenth," which was well within tolerance for this project.

The crew used another Trimble R8 as a base station and relied on relatively few Army Corps of Engineers bench marks (they were surprisingly sparse near the floodwall work). They used a high-precision geodetic network five miles away to set control on the California Coordinate System of 1983 (Zone II) and NGVD 1929. Dickey had some control in the area from previous work on a flood control project; the crew densified control locally for this project.

As with all of Cinquini & Passarino projects, safety was a priority. Work was done on a beautiful and calm January day; life vests were issued, safety talks were conducted and standard safety procedures were followed. And Dickey was on site for some of the project, as well, monitoring events from shore to see for himself how the new methodology was working out. In the end, all fieldwork--six hours for establishing control and six hours of boat time--was accomplished ahead of schedule and without mishap.

Deliverables included typical CAD files and simple topographic maps with contours. "The topo maps were just what we needed for the designers to get started on the next phase of the project," Tomko says, "and the new control will aid our inspectors when construction begins." Tomko was also pleased with the project schedule, saying that he had results within two weeks of assigning the project, which was faster than he expected.

Trying something new can be a gamble, but Dickey is happy with the results of his experiment. "I probably won't do anything different next time," he says. "The project turned out really well, and I now have a much better idea of how much time is saved doing it this way."

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