Project Spotlight

DREDGING FOR DEVELOPMENT

The West Shores Development

- Loras A. Klostermann, P.E., HWS Consulting Group, Inc.

There are many interesting engineering projects completed within Nebraska each year. High rise buildings and innovative designs are highly visible examples of area engineering accomplishments. However, some of the most interesting projects for me have been those that incorporate well-used construction tools in a new way to provide an economical solution to construction.

Dredges have been used for many years within the major river floodplains in this area to retrieve sand and gravel deposits from below the groundwater level. As the resulting sandpit lakes took shape, they became havens for wildlife and recreation. Housing has sprung up around many of these lakes. However, since development was an afterthought after sand and gravel extraction was completed, some constructability problems have been found. Current flood-related regulations require a minimum elevation of the lowest finished floor of any structure to be 1' above the regulatory flood elevation and basement levels are usually not possible. Although many housing areas around existing sandpit lakes were formed by additional dredging of sand and gravel along the shoreline in order to provide foundation support materials, areas of predominately overburden clay deposits exist around portions of some of these lakes. During the latter part of the 1980's a need for a planned lake community within the combined floodplains of the Platte and Elkhorn Rivers was realized.

Planning for the West Shores development started over ten years before construction began. The square mile of land southwest of the intersection of Highway 275 and Dodge Street in western Douglas County was a flat farm field. Portions of the property exhibited poor drainage, resulting in poor conditions for crop production due to excess moisture. A center-pivot irrigation system once existed over a portion of the property to provide sufficient moisture for crop production during drought years. Periodic flooding occurred across the site, but nothing about the site had the appearance of a lake. Although the area road ditches around the perimeter of the site carried runoff water from the area, the site is not adjacent to the Platte or the Elkhorn River channels. The Elkhorn River is located 1.25 miles to the east of the east edge of the property and the Platte River is located 2 miles west of the west edge of the property.

In addition to the usual studies of environmental impact of the site including wetland delineation and floodway determinations, an extensive study of the area surface and groundwater hydrology was required. Groundwater levels below the site were studied over a ten-year period. Based on the groundwater studies and the direction of groundwater flow , normal groundwater levels below the site were determined. It was found that the floodway on the west side of the Elkhorn River extends more than 1.25 miles west of the channel within the eastern part of the proposed development. Wetlands were delineated, many along excavated drainage ditches across the site and required mitigation.

Engineering aspects of the resulting housing lots were specified and borings to determine subsoil conditions were advanced at three periods during plan development. Subsoil conditions varied greatly as significant areas of thick sand deposits existed below portions of the site with no sand in other portions. On the east side of the site, the clay deposits were soft to very soft and contained naturally organic materials buried when the river channels meandered through this area. At the west side of the site, substantial deposits of very stiff clay were encountered. Some of the clay deposits had low to moderate plasticity, but most of the near surface clays had high plasticity. After several iterations, a lot and lake layout began to take shape based on the available subsoil data and geometry requirements of a boating lake. To the extent possible, the lake was to be formed from the areas of predominately sand subgrade. Peninsulas that extend into the lake were proposed, based on locations of predominately clay subgrade below the site.

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Each lot had to be capable of supporting a large residence. Lots that allowed construction of walkout basement levels were deemed necessary, requiring a substantial amount of fill for streets and front yards. Use of existing clay deposits was restricted by the high plasticity. A grading plan that took advantage of the sand deposits below the site began to take shape. The grading plan provided for the placement of compacted sand fill below each building lot. Based on the regulatory flood levels, a minimum basement floor level was determined. Below the building lots the grading provided a minimum thickness of compacted sand fill below the basement levels for foundation support. The thickness of sand below the individual building lots generally ranged from 5' to 10', depending upon subsoil strength as it varied across the site and the difference in elevation from the natural soil grade to the finished soils surface grades. The cross section utilized a fill section within the building areas that extends to a sand beach. Area sandpit lakes were studied to determine appropriate inclination of the sand beach at the shoreline and below the shoreline to allow stable beach locations without the need for intrusive walls or massive riprap structures.

In fill areas, the design utilized the strength of the sand fill for foundation support. Clays remaining below the sand fill were insulated from significant changes in moisture content by the layer of fill above them, resulting in small shrinkage and swell volume changes. The shrubs and trees that existed over portions of the site were removed before filling, but the topsoil clays remain below the fill. In cut areas that would eventually become the lake, the clay overburden was excavated by backhoes. Trucks quickly became bogged down in the moist alluvium. A fleet of Challenger tractors, each pulling a single scraper pan, were used to carry the topsoil and overburden to the designated park and green-space areas around the perimeter of the project area. However, the wet site materials could not be effectively loaded unto the scrapers by pulling them across the cut areas. The scrapers needed to be top-loaded with backhoes. In addition to providing a soil base for perimeter landscape areas, the overburden clays also acted as a perimeter dam to contain the dredge materials during placement.

Excavating the sand deposits below the site with backhoes was not effective. Two dredges were used for a period of about two years to excavate the sand for fill in the housing lots. Although a fleet of equipment was required to removed the overburden ahead of the dredges, each dredge requires only a small amount of equipment to place the sand fill. After a shallow pond was excavated onto which the dredge pontoons could barely float, the dredging operations begun. Water and sand were pulled from the lake, through the dredge's cutting head by powerful pumps. The material was discharged though a piping system that allowed for placement of the dredge materials on the building lots and to the locations as required. A single backhoe was required near the end of the discharge pipe to move the end of the pipe and aim the discharge. In addition to the backhoe, a bulldozer was stationed with each dredge to properly direct the channels of return water flowing back to the lake from the dredge deposition areas.

Compaction of dredge material is not instantaneous. The compaction occurs gradually as excess water seeps from the material, with the compaction starting near the top of the sand deposit immediately after placement and extending to the base of the deposit as the excess water is allowed to drain. During dredging, track-mounted backhoes and bulldozers can travel on the new sand deposits immediately as the sand is being placed. An area of transition was always found at the leading edge of the sand deposit, where the dredge fill was less than 1' thick due to poor subsurface water drainage properties, resulting in unstable edges during dredge sand placement. However, a track-mounted bulldozer or backhoe had no trouble traversing these edge areas. Within a couple of days after dredge sand placement, the upper surface was

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firm enough to allow travel with four-wheel drive trucks and automobiles. As stated above, the compaction of the dredge sand was a gradual effect. As long as excess water was draining from the embankments, compaction of the sand was continuing. Significant water seepage from the sand placement at any particular location on this site occurred from 3 to 6 months after dredge material placement.

Since the dredge fill did not compact readily, compactive effort could not be tested with gauges at the time of placement. To access the compaction of the sand fill, the finished embankments were tested for relative density values with a drill rig and the standard penetration test. These tests generally found that the sand exists in a medium dense condition after placement. Also of concern was the consolidation of the clay subsoils due to the placement of the new embankments. Consolidation was studied using 48 settlement plates set around the entire subdivision. Construction of houses did not begin until measurements confirmed consolidation was nearly completed.

The alluvium below the West Shores development did not consist of clean sand deposits exclusively. Silt and clay deposits were found intermixed and interlayered within the sand deposits. Soft clay deposits below the east half of the site could be pumped with the dredge. Excavation of the clay by the dredge appeared to be a problem for the suitability of the resulting fill materials. However, we found that the soft clay deposits generally remained suspended in the return water, allowing the clays and most of the silt materials to be naturally segregated by the water flow action and be carried back to the lake. Samples of the water returning to the lake found that about one-fourth of the return was suspended clay and silt within the water. Excavation of the dredge embankments found only a very small percentage of the clay material remains within the sand fill matrix. When covered by winter ice, the clay was found to substantially flocculate and the water condition to greatly improved.

The dredges could not effectively excavate stiff clay deposits. A significant deposit of stiff to very stiff alluvial clay was uncovered at the southwest corner of the lake. Fortunately, since the stiff clay deposits contained no significant sand seams, that area could be artificially dewatered to allow normal excavation with a group of backhoes casting the material to successively higher levels, until the materials could be top loaded into the scrapers. These clay materials were also used to dress the edges of the site. A portion of the clay overburden was spread over the site away from the sand beaches in a 12" lift to provide a growing medium and surface erosion protection.

Based on the groundwater levels measured during site investigation over a ten-year period, a planned lake level of 1111.5′ was determined. Water within the lake is the result of normal groundwater flow within the area alluvium. The plan level allowed control of the lake level through a discharge pipe and flow control structure. Flow through the pipe can be effectively controlled through adding or removing gate boards within the small control box. As an added benefit, the discharge water was channeled through the mitigated wetland area formed within the floodway area along the east side of the project area. Wetland plants were seeded and hand planted within the mitigated wetland area. Discharge water eventually makes its way into the existing roadway side ditch along the west side of Highway 275 at Pacific Street. No change in the grade or configuration of the Highway 275 roadway ditches was done for this project.

The previous groundwater data found that the groundwater level varies greatly in this area from periods of excess rainfall and flooding to periods of drought. Use of the gravity flow discharge system has effectively controlled the lake level to within 1.5′ of the plan level. During area floods, the lake level has been measured to generally rise no more than 1′ above plan level. This past spring, the lake level was found to have risen about 1.5′ above plan elevation, but this was the result of a piece of construction debris being jammed into the outlet pipe, constructing the outlet flow. During the past two years the area has been plagued by drought. However, the level of West Shore Lake has remained no lower than 1.5′ below the plan elevation, allowing utilization of the lake for its intended recreational purposes.

In addition to using dredging as a mechanism for grading construction, the project also involved the creation of an island within the lake. Planning of the island included the placement of trees and placing riprap with trucks before the lake around the island was excavated. The island is mainly inhabited by flocks of geese. The marina is surrounded by a vinyl sheet pile wall supported by a wood waler and tiebacks designed for marine conditions. The sheet pile wall has performed well in spite of heavy ice buildup during winter periods.

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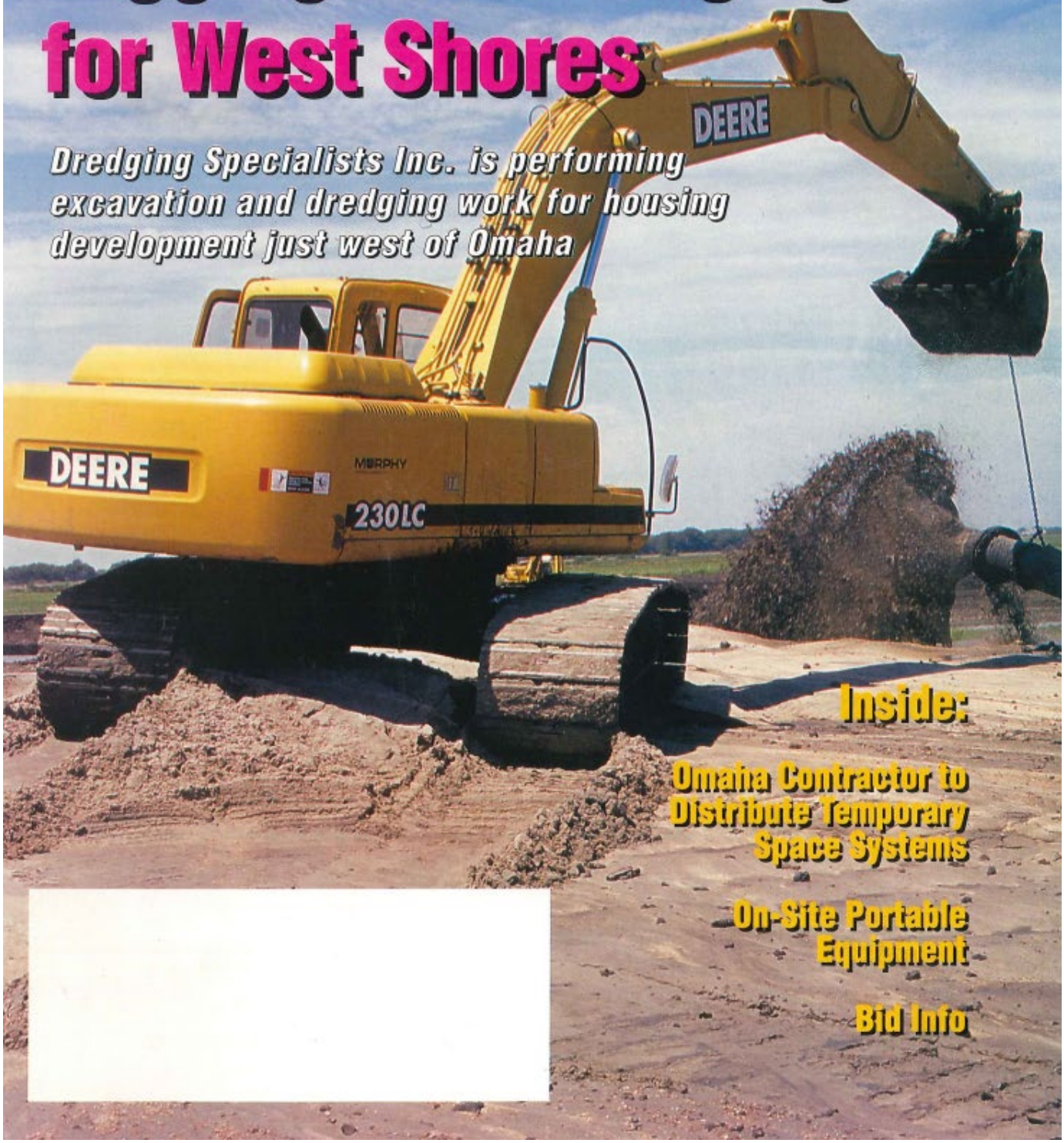
Digging and Dredging for West Shores

Dredging Specialists Inc. is performing excavation and dredging work for housing development just west of Omaha



Inside:

COVER STORY

Digging and Dredging for West Shores

Dredging Specialists Inc., Omaha, uses a John Deere 450LC excavator to load dirt into a Rome 14-yard tow-behind scraper being pulled by one of the contractor's three Caterpillar 75E Challengers.

Omaha contractor is performing excavation and dredging work for future $150 million housing development just west of Omaha.

Story and photos by Scott Judy

One recent trend in housing development is the idea that subdivisions can be more than just groups of homes. Instead, developers are making at least some of them into self-contained communities.

West Shores, a 242-lot upscale development under construction just west of Omaha with a total price tag reportedly over $150 million, appears to be an example of this idea. Among other amenities, it will feature a 202-acre lake big enough for skiing and other recreational uses, a marina, its own shopping center, tennis courts, and a restaurant overlooking the lake.

Presently, Dredging Specialists Inc. (DSI), Omaha, is at work on the preliminary excavation portion of this overall project, with a contract of over $6 million with project owner Century Development Co., also located in Omaha.

Project overview

According to Dave Janke, owner of Dredging Specialists Inc., it should cost approximately $20 million to build the project's 202-acre lake and accompanying infrastructure. DSI's contract, which covers the excavation and dredging for the lake, as well as some initial excavation for the housing development itself, amounts to about $6 million.

DSI began its work the latter part of this past June. Though the company's contract with the project owner covers a period of three years, it includes considerable incentives for DSI to accomplish its work earlier than that.

"We've got a bonus in it to get it done in two (years)," says Janke, "so we're going for it. We should be able to get it. If everything goes the way it's been going, we'll hit it no problem."

The first focus of the project is the construction related to the 202-acre lake. DSI's approach to this effort is two-pronged. First, the contractor is excavating out approximately the top three feet of soil in the area of the lake with a couple of John Deere excavators.

This excavation has been challenging due to the conditions of the job site. Initially, Janke thought he would utilize the traditional combination of excavators and haul trucks to handle this

The contractor's John Deere 850C LGP dozer shapes some of the dredged sand material into hills.

work. However, due to the wet site conditions, this was not going to be possible.

"On this ground, we've got such a high water table," explains Janke. "The water table's only down three feet. We tried (some) big trucks in here and they wouldn't go in here. We had a great big eight-wheel drive tractor in here last week: it just made tracks and sunk."

The only machine Janke found that actually could work in such wet soil conditions and still haul considerable amounts of dirt was Caterpillar's Challenger tractor. As a result, DSI now has a fleet of five 75E Challengers pulling 14-yard Rome tow-behind scrapers. Instead of loading them in scraper fashion, Janke is utilizing a Deere 450LC as his primary excavator to fill them with dirt. The contractor is also using Deere 320LC and 230LC excavators for other aspects of the project.

"With this ground like this, it's easier to do it this way," says Janke of loading the Rome scrapers with his excavators. "It's not as hard on the equipment. Otherwise you're scraping and when it does rain, you've got this (muddy job site) and you can't work in it at all. Here, it rains and the next day we're working."

Overall, the type of equipment he's using for this excavation work, says Janke, "Is the best combination of stuff we can get out here, I think."

He was especially impressed with the way the Challengers fit the needs of this job. "I really liked them," he says. "This seemed like just the right

DSI tried to utilize trucks on this project, but because of the site's high water table found that the Cat Challenger tractor was the only piece of equipment that could haul material effectively.

A Deere 230LC excavator holds the end of the dredge's pipe as material flows out. According to Dave Janke, with DSI, about 30 percent of the dredged material is solids.

application for them."

The Cat Challengers are hauling much of this excavated dirt to the perimeter of the job site, where DSI is using it to construct 15-foot berms that will encircle the housing development. In all, it is roughly four miles around the perimeter of the development.

After the Deere excavators dig out the top three feet of dirt, DSI is using two dredges to pump out the rest of the material, which amounts to about 2.2 million yards of sand. The contractor began the job with one dredging unit, but in mid-August brought a second, identical dredge to the project.

Each dredge will pump out this sand material through a 14-inch pipe, at a rate of about 7,000 gallons per minute. Only about 30 percent of that dredged material will be solids, however, with the remaining water returning to the lake. In all, Janke estimates that each dredge is removing about 400 yards of sand per hour.

These dredged solids are being placed where the development's lots are to be located, forming the preliminary foundation for the future development. Because of the manner in

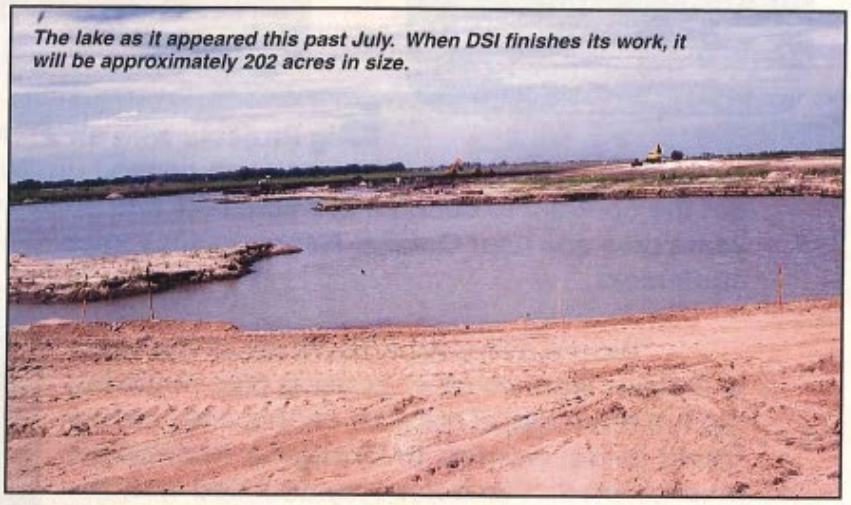
The dredge DSI is using on this project will pump material through a 14-inch pipe, at a rate of about 7,000 gallons per minute.

which this material is being placed, there is no further compaction effort required, with the water acting to almost instantly provide nearly 100 percent compaction, Janke says.

Once the sand is in place, DSI will then place approximately one foot of the excavated dirt on top of the sand.

Janke expects to wrap up both the excavation work and the dredging work at about the same time.

"We're shooting for the summer of 2001," he says. "We're working six days a week out here. You've got to do that when the weather's good. We'll see how this winter goes. If we can go all winter, we can get ahead." ❑



The lake as it appeared this past July. When DSI finishes its work, it will be approximately 202 acres in size.

DSI a new start for an established contractor

Dave Janke started up Dredging Specialists Inc. a year ago with his brother-in-law, Jim Andersen. DSI is a subsidiary of Janke Plumbing, which has been in business for 25 years.

Technically speaking, as a company, Dredging Specialists Inc. (DSI) is only just over a year old, with only one project under its belt prior to this $6 million West Shores job for Century Development Co.

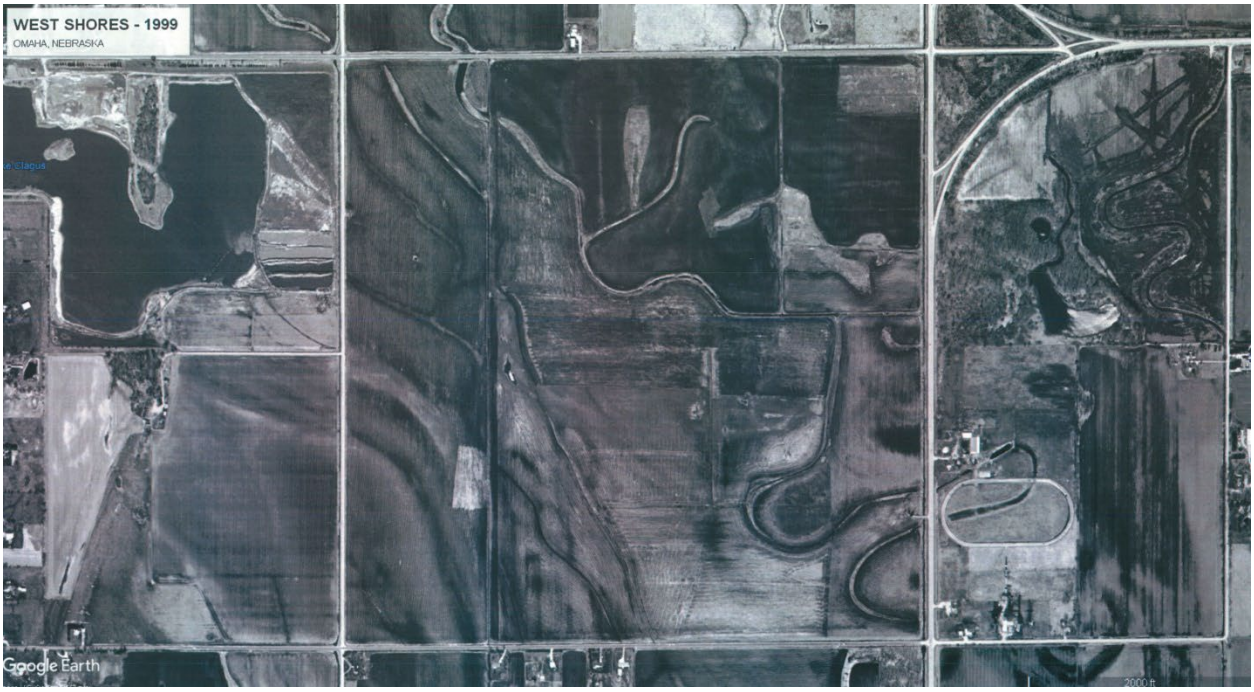
So how is it that such a new company can win such a significant contract, and perform that job with all-new purchased equipment? Actually, DSI is a newly formed subsidiary of Janke Plumbing, Omaha, which Dave Janke has been operating for 25 years doing plumbing, water and sewer construction.

Janke started Dredging Specialists Inc. a little over a year ago with his brother-in-law, Jim Andersen, who has been working in the field of dredging for most of his working life. The company's first job was one Janke and Anderson started last July on Highway 275.

DSI won this contract on the West Shores development project through Janke's long-term relationship with the owner, Frank Krejci of Century Development Co.

"I've worked for him for 20 years," says Janke. "He just knew what kind of work I could do and he wanted someone here to keep an eye on it."

With its current contract, Janke's new company will be able to keep busy for at least a couple of years. ❑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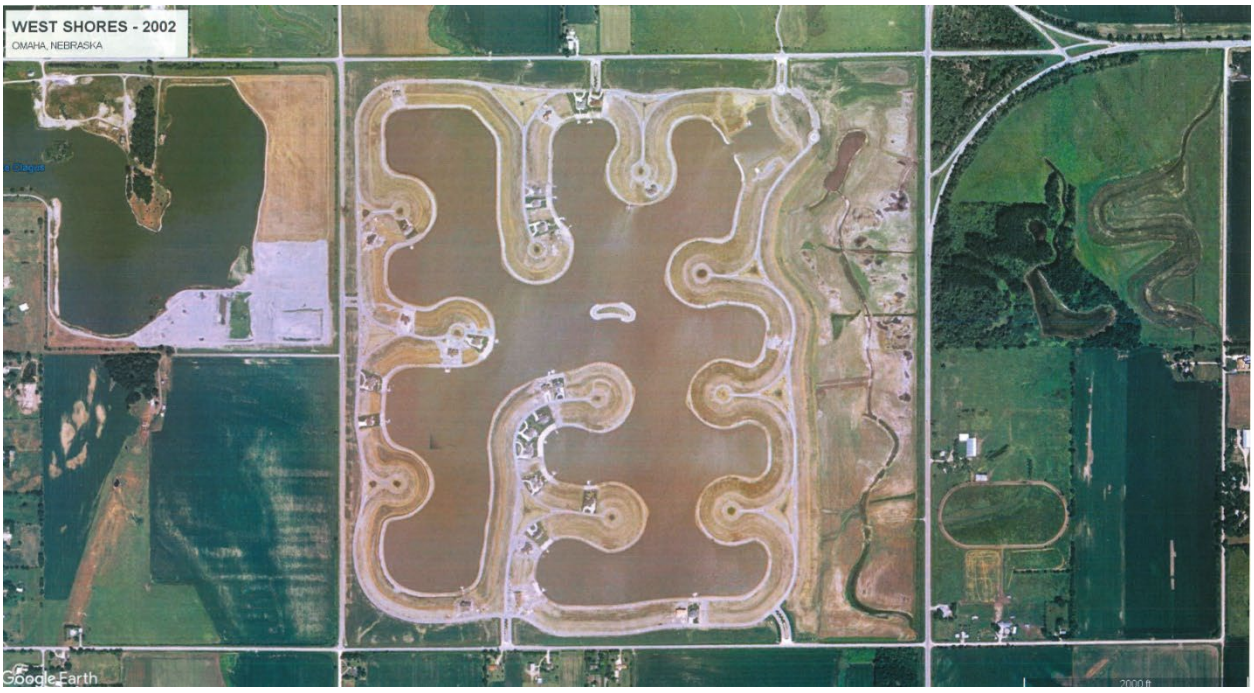
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