State: Alaska

Borrower Name: Nikolaevsk Incorporated

Engineering Firm: DOWL Engineers
Anchorage, Alaska 99503

RD Contact: John LaVarnway, 907-745-2176

Congressional Information: Don Young – Alaska

Counties: Kenai Peninsula Borough

Keywords: Surface water, Disinfection

Nikolaevsk Community Water System

Description of Problem/Issue:

Nikolaevsk is a community of 250 people located on the southern Kenai Peninsula in south Central Alaska. Russian Old Believers of the Russian Orthodox Christen Church founded the village in 1968. The community is located about 110 miles South of Anchorage and about 20 miles north of Homer. A 6-mile gravel road connects this small town to Anchor Point and the Alaska road system. The town is comprised of about 50 dwellings, a combined elementary/middle/high school, a post office/general store, and an Old Believer Russian Orthodox Christian Church to which most residents attend.

Shortly after settling in the community, the villagers tapped two small creeks on the hillside and built a community water system. The water system was gravity feed with no treatment. As the community expanded to its present day population of 250 people, the water system was overburdened. The Alaska Department of Environmental Conservation(ADEC) and the Environmental Protection Agency(EPA) documented numerous water quality problems in the village, including the presence of fecal coliform and high turbidity. Boil water notices had been more or less continually in effect since 1991. The system had no form of disinfection or water treatment and persisting violations were occurring. The existing system also had inadequate water storage capacity for fire fighting purposes or to simply get the growing community through the daily seasonal flow equalization requirements. Moreover, the elevation of the existing water storage tank did not provide adequate water pressure to serve the houses at the higher elevation points in the village. In short, the system had served the community well during its initial years, but the current requirements of the community and the regulatory climate dictated that a new system be constructed.

The community sought to replace the water system, but they wanted to keep using the surface water creeks. The permit for the community to use the creeks had expired and

there was no site control. The community also wanted the new water system to have hydrants and fire flow capability. The creeks are extremely low flow. In order to use them, site control needed to be established and every drop of water would have to be collected and stored to bridge the community through the dry months.

The community also wanted to minimize the use of chlorine as a disinfectant, and use an automated treatment process.

Solution:

The community worked closely with ADEC's Village Safe Water(VSW) program. VSW works with many small communities providing technical advice, engineering, construction management, and grant assistance. VSW granted the community approximately $50,000 to perform an engineering feasibility study. CRW Engineering Group of Anchorage performed the study, recommending a complete replacement of the existing water system. CRW also recommended that the new water system consider drilling community water wells. A secondary option was presented which allowed for retention of the historical surface water sources, and augmenting the sources with either wells or other surface water creeks. Nikolaevsk endorsed CRW's secondary recommendation.

Using additional grant dollars provided through the VSW program, the community bought the 160 acre watershed and started the design of a new water system. With the watershed now owned by the community, the site control problems were eliminated. The purchase documents have a clause that limits development within the parcel for a twenty-year period. The clause ensures that the land stays a protected watershed.

DOWL Engineers of Anchorage were selected for the design and construction management of the new water system. DOWL designed a water system that fulfilled the requirements stated by Nikolaevsk. There was a strong community desire to not use chlorine disinfection. They were also opposed to using well water, and wanted the system as automated as possible. The surface water sources on the hillside above the community were low flow. Although capable of serving the needs of the community, special design considerations were necessary to properly develop them.

Four low flow creeks were used as water sources. The streams are largely dependent on runoff. Natural springs provide a base flow of approximately 15 gpm each, with runoff fluctuations occurring weekly. Flows can be as low as 15 gpm or as high as 300 gpm per creek. With the large flow variations, adequate water storage was critical. The four creeks were diverted to a 370,000 gallon constructed raw water impoundment. A 320,000 potable water storage tank was built, bringing the total water storage to approximately 700,000 gallons. The community uses approximately 15,000 gallons per month.

The community had gone over twenty years without disinfection of the drinking water. Economics usually dictate that chlorine be used as a disinfectant for small water systems. Nikolaevsk did not want the water system to be chlorinated, but did recognize that the system was legally responsible to disinfect. DOWL designed the disinfection scheme to use a mixed oxidant. The mixed oxidant is composed of hypochlorous acid, chlorine dioxide, and ozone. The oxidant is generated onsite. Using a mixed oxidant to disinfect the water has a few benefits. Chlorine taste and odor are minimized, disinfection byproducts are minimized, and the operation is automated.

Filtration is accomplished using two pressure sand filters. The filters are capable of treating approximately 70,000 gallons of water a day. Polymer is added to assist in coagulation. The polymer addition process has the capability to be automated; when turbidity changes, the polymer feed rate changes. Backwash and filtration have both manual and automatic settings. Filtration is gravity flow, no pumps are needed.

The water is filtered, disinfected, and then pumped back up the hill to the potable water tank. The tank is at high enough elevation to provide fire flow for the community. Prior to the new water system construction, approximately two homes were lost to fire each year. Since the new system was installed, no homes have been lost to fire.

Construction of the new water system used a mix of conventional general contractor construction and force account construction. By building a portion of the project with force account labor, local operators were taught how to properly maintain the treatment and distribution system. The general contractor's portion of the work totaled $2.4 million, while the force account portion was approximately $100,000. USDA/Rural Development contributed $1.5 million to match the State of Alaska contribution of $1.5 million. Federal Department of Transportation contributed $468,000 and the Kenai Peninsula Borough contributed $42,000. The total project cost including all engineering, construction, equipment, and land purchase was approximately $3.5 million.

The facility is owned and maintained by Nikolaevsk Incorporated. The 51 homes connected to the water system each pay $45.00 per month for operation and maintenance. Two water operators are employed, with one of the operators also acting as the water system clerk.

This summary is taken from an unpublished paper co-written by Stewart G. Osgood, P.E. of DOWL Engineers and Michael Wolski, P.E. of ADEC-Village Safe Water Program.