

Public Water vs. Private Well Water

A Comparison



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This fact sheet discusses two common domestic water delivery systems: city or utility water systems and privately-owned well water systems. It covers:

- *The differences between a public water connection and a private well water system, and*
- *Comparison of estimated costs of each system for a typical household in the Fairbanks - North Pole area.*

Domestic water use refers to water used for household purposes, such as drinking and preparing food, bathing, washing clothes and dishes, and watering the yard and garden.

In the Fairbanks – North Pole area, shallow groundwater is abundant and is commonly used to supply water to residents through city or utility water systems that serve many people as well as through privately-owned, non-utility water wells.

The quality of groundwater for domestic use varies significantly by location, as it contains varying amounts of naturally-occurring minerals, metals, and even oxygen. In addition, shallow groundwater is susceptible to contamination from chemical spills, septic leach fields, and other human interactions.

Although both public (city and utility) and private water wells are effectively used to supply water to households, there are substantial differences in the property owner’s personal responsibility for water supply. A privately-owned well system offers greater independence and personal choices regarding water treatment. A public water system requires less homeowner maintenance and guarantees compliance with water quality standards.

The assumptions in this fact sheet represent a middle-of-the road approach to understanding estimated costs. For any given individual situation, costs could turn out to be more or less expensive than shown in this estimate. Comparing the cost of a well water system to a public water connection is not straightforward due to the following factors that vary from household to household:

- Water quality and the level of treatment required or desired;
- Well depths;
- Water system construction details, such as lengths, depths, and insulation quality of supply lines;
- Personal choices in water usage; and
- Personal choices in system maintenance.

Additionally, many individuals perform their own maintenance or replacement of water system parts, while others enlist the service of plumbers or well drillers. Therefore, the estimated operation and maintenance costs described below should only be used as guide. Actual costs may vary greatly for the reasons listed above.

Private well water systems

The property owner is responsible for ensuring a safe, uninterrupted water supply for the household. The water supply lines between the well and the house must remain unfrozen. Periodic testing is recommended to monitor

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for water quality. A power outage will cause an interruption in water supply, unless the owner has a sufficient backup generator. Failure and subsequent replacement of the water system components can also cause an unexpected interruption in water supply.

The primary expenses of a private well water system are the upfront costs of installing the well, pump, pressure tank, and other associated components. Well installation costs vary greatly and are primarily dependent on the depth to an acceptable water source and the quality of the water source. In some areas, water wells must be installed through permafrost. However, even after the water well has been installed, there are operation and maintenance costs throughout the life of the home, as described below.

- In interior Alaska, many private well water systems use heat trace to freeze-protect the supply line between the well and the home. The heat trace may or may not be energized all winter depending on the depth and insulation quality of the supply line, and on the snow depth.
- Natural well water is often high in iron and other minerals and may cause discoloration of clothing and appliances. It may also have an unpleasant taste and smell or contain harmful amounts of arsenic or nitrates. Therefore, various water treatment technologies may be added to the water system to make the water usable. Filter media and treatment chemicals will need to be periodically replenished, and system parts need periodic cleaning or eventually wear out and need replacing.
- Testing well water quality to ensure treatment systems are functioning properly is the responsibility of the well owner.
- Well pumps, controls, switches, and pressure tanks require periodic replacement. Additionally, the well itself may eventually need replacement.

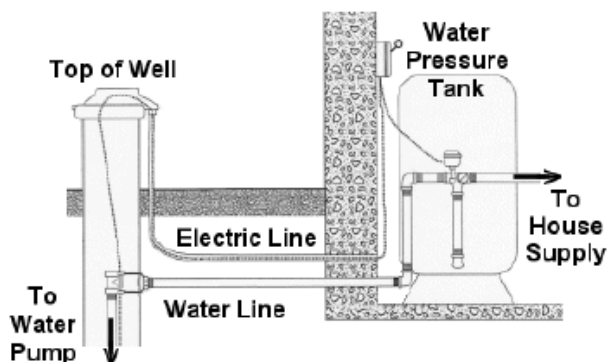
Public water systems

The city or utility is responsible for the water's quality and delivery through the water mains, while the property owner is responsible for the piping between the water main and the house, as well as the house's internal piping. The public water system has backup generators to ensure an uninterrupted supply in case of a power outage. Public water is treated and tested regularly to ensure the water is free of contaminants, and the water quality results are available for review by the public.

The primary expenses of a public water system are the initial connection and the monthly water usage bill. If a recirculating pump is needed (to keep the service line from freezing), there are power requirements and an eventual need for replacement.

What is a typical well water system?

The primary components of a private well water system include the well, an electric water pump with controls, an insulated and heat-traced supply line to the house, a pressure tank, and a treatment system. A simple configuration is shown in the figure to the right. For the cost estimation below, a typical well is assumed to be 100 feet deep, uses a ½ horsepower submersible pump, is 50 feet from the home, has a 1" insulated copper supply line with heat trace, a 33-gallon pressure tank, a sediment filter, and has hard water requiring a water softener. The lifespan of the system components is estimated to be 20 years.



What is a typical public water connection?

The primary components of a city or utility water system are the supply and return piping loop that connects the house to the public system’s water main and the water usage meter. A recirculating pump may be installed on the water loop to prevent freezing, depending on the distance from the home to the water main and whether there is a history of freezing. For the cost estimation below, a typical connection is located 100 feet from the public water main, uses 1” copper piping, and has a 1/12 horsepower recirculating pump that runs continuously for 7 months to prevent freezing. The pump is expected to last 20 years before needing replacement.

What are the operation and maintenance costs?

The operation and maintenance costs over a 20-year period were estimated for both a well water system and a public water system. Table 1 summarizes annual costs for a private water well system, as previously described. Table 2 summarizes annual costs for water provided by a public water connection. Table 3 provides periodic maintenance costs for a private water well system, and Table 4 provides periodic maintenance costs for a public water connection. The Table 3 and 4 costs would be expected to be needed approximately every 20 years. Table 5 summarizes the total costs for both systems.

Table 1: Private Water Well - Annual Operation and Maintenance Costs

	Annual Cost	Basis
Electricity use by water pump	\$3 ^a	2,400 gallons per month per account (Average North Pole single family residential use) ^b \$0.20 per KW-hr ^c
50 feet of heat trace	\$252 ^d	Operated 7 months per year
Sediment filters	\$42 ^e	New filter every two months
Salt for softener system	\$72 ^f	40 pound bag every month
Water quality testing	\$135	1 sample tested for total coliforms, arsenic, nitrates ^g
Total estimated annual costs	~ \$500	Rounded to nearest \$10

Footnotes (references and calculations) for all tables are provided at the end of the Fact Sheet.

Table 2: Public Water – Annual Operation and Maintenance Costs

	Annual Cost	Basis
Electricity use by recirculating pump	\$98 ^h	1/12 horsepower, 7 months operation
Water usage rate	\$350 to \$900 ⁱ	2,400 gal/month average North Pole residential account annual usage; range from 50% of average (1,200 gal/month) to 150% of average (3,600 gal/month) for both Fairbanks (Golden Heart & College Utilities) and North Pole rates. Water rates only; sewer service not included. http://www.northpolealaska.com/sites/default/files/fileattachments/utilities/page/272/2016_utility_rates-approved.pdf http://www.akwater.com/billcalc.php?co=CUC&typ=Single+Family
Total estimated annual costs	~ \$450 to \$1,000	Rounded to nearest \$10

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Table 3: Private Water Well - Periodic Maintenance Costs (Approximately every 20 years)

	Cost	Description
Pump replacement – Pump, wiring, control box	\$800	½ horsepower, submersible
Pump replacement - Labor	\$1,000	Well truck and crew
Pump replacement - Drop pipe	\$75	1 inch Schedule 80 PVC from the pump to ground surface
Pressure tank	\$1,200	33 gallon, value is for replacing a tank with a 10-yr lifespan twice in 20 years
Tank replacement-Labor	\$750	3 hr @ \$125/hr for two tank replacements
Filter and softener system replacement with installation	\$2,000	cost may vary greatly depending on treatment system
Total Periodic Maintenance Cost (every 20 years) – Water Well	~ \$5,830	Rounded to nearest \$10

Table 4: Public Water - Periodic Maintenance Costs (Approximately every 20 years)

	Cost	Description
Recirculating pump replacement - Pump	\$600	1/12 horsepower with bronze or stainless steel volute and impeller
Recirculating pump replacement - Labor	\$188	1.5 hr @ \$125
Total Periodic Maintenance Cost (every 20 years) – City Water	~ \$790	Rounded to nearest \$10

Table 5: Cost Summary

	Water Well	Public Water	Comment
Annual Costs	\$500	\$450 to \$1,000	Public water sensitive to use volume; \$450 for 1,200 gal/month and \$1,000 for 3,600 gal/month
Periodic Maintenance Costs (Every 20 years)	\$5,830	\$790	Maintenance costs for both systems vary depending on quality of replacement parts, homeowner versus professional labor, and time of year maintenance/parts replacement occurs
Total over 20 years	\$15,800	\$9,800 to \$20,800	Rounded to nearest \$100

The costs from Tables 1 through 5 are reviewed below:

- The total estimated annual operational cost for a water well is approximately \$500 versus \$450 to \$1,000 for public water in the North Pole-Fairbanks area.
- Over a 20-year period, the total operating and maintenance costs for a well water system are approximately \$16,000 and the costs for a public water system range between approximately \$10,000 and \$21,000.
- Costs of public water service are very sensitive to use volume.

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- Personal choices regarding water consumption, well maintenance, use of a water softener, and water testing will impact annual water well operation and maintenance costs. Also, the lifespan of the water pump and other components of a home water well system can vary greatly. The 20-year lifespan is an estimate, and individual components may have a longer or shorter lifespan than shown here.

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Sources of Information

This Fact Sheet is an update of 2011 and February 2017 versions. Cost information that was used to complete this analysis was gathered from Golden Valley Electric Association rates, the City of North Pole 2016 Utility Rate Table, Golden Heart Utilities/College Utilities water utility rates, Pollen Environmental, LLC, a local water treatment systems provider, local plumbers, local well drillers, and local plumbing suppliers. Annual water consumption was calculated from data from the City of North Pole and the US Census Bureau. Cost estimation equations and other sources referenced in the previous tables are shown below.

^a

$$\begin{aligned} & \frac{2,400 \text{ gallons}}{\text{month} \cdot \text{household}} \times \frac{12 \text{ months}}{\text{yr}} = \frac{28,800 \text{ gallons}}{\text{household} \cdot \text{yr}} \\ & \frac{28,800 \text{ gallons}}{\text{household} \cdot \text{yr}} \times \frac{1 \text{ yr}}{365 \text{ days}} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = \frac{0.055 \text{ gallons}}{\text{min} \cdot \text{household}} \\ & \frac{0.055 \text{ gallons}}{\text{min} \cdot \text{household}} \times 100 \text{ ft deep well} \times \frac{1 \text{ Hp} \cdot \text{min}}{33,000 \text{ ft} \cdot \text{lb}} \times \frac{8.345 \text{ lb}}{\text{gallon}} = \frac{4.08 \times 10^{-3} \text{ Hp}}{\text{household}} \\ & \frac{4.08 \times 10^{-3} \text{ Hp}}{\text{household}} \times \frac{0.746 \text{ KW}}{\text{Hp}} \times \frac{1}{0.80 \text{ pump efficiency}} \times \frac{1}{0.80 \text{ motor efficiency}} = \frac{4.75 \times 10^{-3} \text{ KW}}{\text{household}} \\ & \frac{4.75 \times 10^{-3} \text{ KW}}{\text{household}} \times \frac{\$0.20}{\text{KW} \cdot \text{hr}} \times \frac{24 \text{ hr}}{\text{day}} \times \frac{365 \text{ days}}{\text{yr}} \approx \frac{\$3}{\text{household} \cdot \text{yr}} \end{aligned}$$

^b 2,400 gallons of water per month per single family residential account (City of North Pole average). Changes in water use and well depth do not dramatically change annual power costs for private well owners. For 1,200 gallons of water per month, the annual power cost drops to ~\$1.50; for 3,600 gallons of water per month, the annual power cost increases to ~\$4.50. For a 200-foot deep well and 2,400 gallons of water per month use, the annual power cost increases to ~\$5.50.

^c Representative Golden Valley Electric Association rate.

^d

$$\frac{5 \text{ W}}{\text{ft}} \times 50 \text{ ft} \times \frac{7 \text{ months}}{\text{yr}} \times \frac{30 \text{ days}}{\text{month}} \times \frac{24 \text{ hr}}{\text{day}} \times \frac{1 \text{ KW}}{1000 \text{ W}} \times \frac{\$0.20}{\text{KW} \cdot \text{hr}} = \frac{\$252}{\text{yr}}$$

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e

$$\frac{1 \text{ filter}}{2 \text{ months}} \times \frac{12 \text{ months}}{1 \text{ yr}} \times \frac{\$7}{\text{filter}} = \frac{\$42}{\text{yr}}$$

2.5" x 10", 5 micron string filters ranged from \$4.61 to \$8.77 each at Fairbanks Lowes and Home Depot in November 2017.

f

$$\frac{12 \text{ bags}}{\text{yr}} \times \frac{\$6}{\text{bag}} = \frac{\$72}{\text{yr}}$$

40 lb bags of non-iron reducing water softener salt ranged from \$5.38 to \$6.41 per 40 lb bag at Fairbanks Lowes and Home Depot in November 2017.

^g The National Groundwater Association recommends annual testing for total coliform and nitrates and local groundwater contaminants, such as arsenic. Additional or fewer analyses may be recommended based on the location in the Tanana Valley.

h

$$\frac{1}{12} \text{ Hp} \times \frac{0.746 \text{ KW}}{\text{Hp}} \times \frac{1}{0.80 \text{ pump efficiency}} \times \frac{1}{0.80 \text{ motor efficiency}} \times \frac{\$0.20}{\text{KW}\cdot\text{hr}} \times 7 \text{ months} \times \frac{30 \text{ days}}{\text{month}} \times \frac{24 \text{ hr}}{\text{day}} = \$98$$

ⁱ City of North Pole 2016 Utility Rate Table, Utility Services of Alaska (Fairbanks) College Utility and Golden Heart Utility Rates for 1,200 gallons per month; 2,400 gallons per month; and 3,600 gallons per month. Water service only (no sewer).

	Monthly		Annual		Total	
	Fairbanks ¹	North Pole ²	Fairbanks	North Pole	Fairbanks	North Pole
Monthly Base Rate	\$8.50	\$5.00	\$102.00	\$60.00		
1,200 gallons per month	\$8.98	\$20.46	\$107.76	\$245.52	\$400.80	\$341.52
2,400 gallons per month	\$18.00	\$40.92	\$216.00	\$491.04	\$514.08	\$623.04
3,600 gallons per month	\$26.93	\$61.38	\$323.16	\$736.56	\$626.52	\$904.56
Other charges (1,200 gal)*	\$4.60	\$3.00	\$55.20	\$36.00		
Other charges (2,400 gal)*	\$5.02	\$6.00	\$60.24	\$72.00		
Other charges (3,600 gal)*	\$5.46	\$9.00	\$65.52	\$108.00		
Meter**	\$11.32		\$135.84			

¹ Source: Golden Heart Utilities and College Utilities bill calculator
(<http://www.akwater.com/billcalc.php?co=CUC&typ=Single+Family>)

² Source: City of North Pole 2016 Utility Rates
(<http://www.northpolealaska.com/utilities/page/2016-utility-rates>)

*Other charges include regulatory charges, fire protection (Fairbanks), and plant improvement charges

**Assume 3/4-inch meter per bill calculator website