South Slope Watershed

In 1871 General William Jackson Palmer began selling lots and building Colorado Springs. As the town began to grow, a permanent and clean source of water became a major concern to the citizens of the new community. Shallow wells were the first major source of water, closely followed by the El Paso Canal. The six mile long El Paso Canal pulled water from Fountain Creek near present day 33rd Street and delivered it to a system of lateral ditches in what we now think of as downtown Colorado Springs. A grasshopper plague in 1873 polluted both of these early water sources to the point that a better solution had to be found.

In 1880 an intake was built on Ruxton Creek, just west of Manitou Springs. Colorado Springs now had a source of clean water that was piped from the source, but water supplies needed to grow as the town grew, so the City of Colorado Springs began acquiring the land that we now call South Slope in 1890. The land was purchased from the U.S. government in sections over a period of 30 years. South Slope currently has seven reservoirs, one small natural lake and two water conveyance tunnels.

Lake Moraine is a natural lake that was enlarged by adding a rock dam in 1891. It has a capacity of 1,323 acre feet and sits at an elevation of 10,247 feet. It is the water source for the Ruxton Hydro.

Mason Reservoir (Reservoir #4) was built in 1904; it has a capacity of 1,965 acre feet at an elevation of 10,911 feet.

The St. Johns Tunnel was also completed in 1904. It brings water from Mason Reservoir through the divide down to Lake Moraine. The tunnel was named after J. C. St. John who was City Council president and Water Committee chairman in 1904.

McReynolds Reservoir (Reservoir #5) was completed in 1905. It has a capacity of 2050 acre feet at an elevation of 10,914 feet and was later named after B.B. McReynolds who became the Water Department superintendent in 1909. Both Mason and McReynolds Reservoirs were built on the site of the Seven Lakes. The Seven Lakes were seven natural lakes that were once a popular vacation site for local citizens. There was even a hotel and resort built on site. Once the two large reservoirs were built all traces of the Seven Lakes and the resort were erased.
The Strickler Tunnel was built to convey water from the West Beaver Creek Drainage into the South Slope area. Construction started in 1898 of the 6,427 foot long tunnel, which was named after William A. Strickler who was elected mayor in 1888 and 1893. Construction was far more difficult than anticipated, so it took over four years to complete. The Minnehaha Hydro Plant was constructed to supply power to operate the air compressors, pumps and lighting need to bore the tunnel. The tunnel replaced the Timberline Flume, which was a seven mile long wooden water flume, built in 1893 and used to move water from the East Fork of West Beaver Creek to Boehmer Creek. The flume froze solid every winter. Parts of the flume still exist and are easy to spot if you know where to look.

The Ruxton Hydro Plant was built in 1925 and is still operational today.

South Slope was closed to the public for watershed protection when the area came under Colorado Springs control in the 1890s. In 2014, portions of South Slope opened to the public on a limited basis during the summer months.

**Boehmer Reservoir** (Reservoir #2) was built in 1894 and it has a capacity of 541 acre feet at an elevation of 11,280 feet. The plan was to build a reservoir #3 just downstream from Boehmer, but it was never built.

**Bighorn Reservoir** (Reservoir #7) was built in 1896 and has a capacity of 191.1 acre feet and sits at an elevation of 12,076 feet.

**Wilson Reservoir** (Reservoir #8) was also built in 1896. It has a capacity of 669.1 acre feet and sits at an elevation of 11,673 feet.

**Big Tooth Reservoir** (Reservoir #1) was built in 1928. There was a large construction camp built at the dam site, some evidence of which remains today. An electric overhead cableway system was built to move the rock and gravel for dam construction. The reservoir was built with a capacity of 648 acre feet, but the spillway was lowered in 1985, so the capacity is now 203 acre Feet. It sits at an elevation of 9,320 feet. It is named Big Tooth because of its shape.

**Dead Lake** is the small natural lake on top of the divide between Mason Reservoir and Lake Moraine. It is so named because it has no natural inlet or outlet, but the water is crystal clear.
The first railroad into the Cripple Creek Mining District was the narrow gauge (three-foot gauge) Florence and Cripple Creek Railroad. It mainly carried gold ore, Canon City coal and passengers between Florence and Canon City and the Cripple Creek District. It began operation in 1894 and was abandoned in 1917 due to a second major flood in Phantom Canyon which destroyed miles of track.

The Colorado Midland Railroad began construction of a standard gauge (56.5-inch gauge) railroad from Colorado Springs up Ute Pass in 1887. It eventually reached Leadville, Aspen and finally Grand Junction. In 1895 the Midland Terminal Railroad, also standard gauge, was built from Divide to the Cripple Creek Mining District. The Midland Terminal carried gold ore down to the Gold Mills that were once located in Old Colorado City. It operated until 1949, while the Colorado Midland was abandoned west of Lake George in 1917.

The Colorado Springs and Cripple Creek District Railway, or the Short Line as it was called, was built in 1901 from downtown Colorado Springs to the Cripple Creek Mining District. It was also a standard gauge railroad and its yard and repair shops were located where the Martin Drake Power Plant is today.

Due to the very scenic route it took to get to the district, it attracted large amounts of tourist passengers; even President Teddy Roosevelt rode the line. It was abandoned in 1920 and the roadbed was converted to Gold Camp Auto Road in 1922. The line had nine tunnels along its route and met the Stage Road to Cripple Creek at the small community of Duffields. The lower half of Gold Camp Road is now closed to vehicle traffic, so now the Old Stage Road is used as part of the route.

The Manitou and Pikes Peak Cog Railway, which passes through South Slope, was built in 1891 and continues to carry passengers to the summit of Pikes Peak. It is a standard gauge, nine-mile long cog railway, which uses the Abt Cog System. The railway has grades as steep as 25 percent. It originally used steam locomotives, one of which is still operational (#4) and it and a restored original coach are used occasionally for special occasions. The modern two-car trains are diesel-hydraulic powered and were made in Switzerland.
South Slope/Manitou Area of Pikes Peak

- Pikeview System
- Bear Creek System
- Ruxton Creek System
- South Suburban System
- South Slope System
Lake Moraine Hydro Electric Plant

Even though Colorado Springs is situated in a semi-arid part of the country, hydropower has been utilized here since 1898, and its use has continued to grow. When Colorado Springs was in its infancy, the city fathers wisely acquired land and water rights on the slopes of Pikes Peak to supply the town with clean and fresh mountain water. As the city grew, electric power became available by 1886, and by 1888, 60 cycle AC power was being produced from coal-fired steam power plants. It wasn’t long before someone thought of using some of that water flowing down to town for the production of power.

Irving Howbert, a Colorado Springs banker, was granted a franchise by the city in 1897 to generate electric power with water in the city’s water system.

His plan was to construct an electrically powered railway from Colorado Springs to the Cripple Creek mining district. The railway was built and was known as Colorado Springs and Cripple Creek District Railway, but was steam powered, not electric. The railway in and around the Cripple Creek district was electrified for the streetcars which provided daily transportation for the miners and the citizens in the area.

To power the streetcars, this hydro plant was built about one mile southwest of Lake Moraine on the South Slope of Pikes Peak inside the South Slope Watershed.

The contracting firm of Mackey and Ross built the pipeline and power plant for $54,664, and turned it over to the railway on July 1, 1898.

Water to power the Lake Moraine Plant came from the Dead Lake divide, dropping 900 feet down to the plant through a 16-inch diameter pipeline. The intake for the pipeline was located just below where Boehmer Reservoir is today.

The powerhouse was built as a log structure, with tongue and groove siding on the interior. The exterior was painted red with white windows, doors and trim.
Inside the power house was a 5-foot diameter Pelton turbine, with flywheel, spinning a 225 kW, 25 cycle, three phase, 6300 volt alternating current generator at 500 rpm. The flywheel weighted 4,600 pounds and was necessary to help maintain a constant generator speed since the load on this generator varied greatly as the street cars started and stopped on the steep grades.

Most street railway power plants at this time produced 25 cycle power and this plant was no exception. Turbine power output was maintained by a belt driven Replogle Electric Governor operating a deflector plate at the nozzle. The deflector plate would cut in and out of the nozzle stream, which would vary the amount of water striking the turbine, varying the turbine's power output. The 22 Pelton buckets on this turbine were of Lester Pelton's original design, patented in October 1880. A small 18-inch Pelton turbine powered the exciter which supplied the direct current for the magnetic field of the large generator. This tiny plant operated until 1910, when it was abandoned, because it was too small and too remote to adequately supply the power needed by the railway. By that time the railway was receiving power from a small steam plant it had constructed at Cameron (near Victor) and was purchasing power first from the La Bella steam plant and later from the Skaguay hydroelectric plant.

The Lake Moraine plant still stands, as does the two room operator's house, but both are in poor condition. The turbine and massive flywheel are still in place and the generator is buried under the remains of the collapsed plant roof.
Minnehaha Hydro Electric Plant

The second hydro plant to be built on Pikes Peak was built to help supply Colorado Springs with water. In 1896 the city obtained from the U.S. government 3,100 acres on the southwest slope of Pikes Peak, in the West Beaver Creek drainage. The additional water rights were a blessing, but a tunnel would need to be drilled to bring the water through the ridge over to South Slope. In 1898 the Strickler Tunnel was begun, but power was needed to help drive the bore because of unexpectedly difficult ground.

On Sept. 7, 1898, a franchise from the City of Colorado Springs was granted to George Jackson, one of the tunnel contractors. This franchise gave him the right to build and operate an electric utility using water in the city’s water system. A plant site was chosen at Minnehaha, which was a small community on the Manitou and Pikes Peak Cog Railway, about two miles from Manitou Springs.

This plant, built in 1898, used water pressure developed in a pipeline descending 600 vertical feet down Son of a Gun Hill, which was one of the steepest sections on the Cog Road. The little Minnehaha Plant had a 36-inch Pelton turbine spinning a 60 cycle, three phase, 3,500 volt AC generator at 600 rpm. The generator was built to an older design with a stationary magnetic field and a rotating armature. It supplied power for the air compressors, ventilation and lighting of the tunnel project for four and a half years, until the tunnel was finally complete.

In 1901 wires were run to Manitou Springs where it supplied power intermittently until it was abandoned in 1907. The wooden plant building was removed sometime in the 1920s and today all that remains is the intact penstock and concrete foundation of the turbine and generator. The generating unit was removed in 1911 and installed in Green Mountain Falls, where it was operated by the Empire Water and Power Company until it was abandoned in 1931.
Skaguay Hydro Electric Plant

The third hydro plant built on the slopes of Pikes Peak really had nothing to do with the City of Colorado Springs, but it did use water from the Pikes Peak drainages.

Skaguay was built in 1900 to power the mines and mills of the Cripple Creek district. Water for Skaguay was captured at Skaguay Reservoir and transported four miles to the plant by way of a 30-inch diameter wooden penstock. The final 1,152 foot fall to the plant was through a steel penstock. Located in the bottom of the very remote West Beaver Creek canyon, it could only be accessed by way of a steep incline railway built on top of the penstock or by a very long hike.

Inside the brick powerhouse were four identical generating units and two excitation units. Each generating unit had two 66-inch Pelton turbines, and a 7,000 pound flywheel, rotating a 450 kW, 30 cycle, three phase AC generator at 450 rpm. The two excitation units provided all of the necessary field current for the big machines and current for lighting, heating and cooking in the four operator’s cabins.

When it was built, 30 cycle power was used for power (motors, pumps, hoists, etc.) while 60 cycle power was used for lighting only. Later, when 30 cycle power fell out of use, the power was transmitted to the Clark Plant in Canon City where it went through a rotary frequency converter (a 30 cycle synchronous motor coupled to a 60 cycle generator) to change it into 60 cycle, and then transmitted back to the district.

This plant operated until 1965 when it was abandoned due to two miles of pipeline being plugged up with silt from a major flood. The plant is largely intact to this day because of its remote location.
Manitou Hydro Electric Plant

The Pikes Peak Hydro Electric Company began construction of the Manitou Hydro Plant in 1903 and completed it in 1905, with the first unit going on line on Feb. 15, 1905. The pipeline for the new hydro plant was started on July 6, 1903, and was completed on July 5, 1904. The plant was designed and built by a very talented engineer by the name of George A. Taft and his business partner William A. Otis. Prior to building the Manitou Hydro Plant, Taft built the coal-fired Papeton Plant, which also provided Colorado Springs with electric power. The famous Manitou Incline Railway was built by the power company to bring the pipe sections up the hill and install them in place. Once construction was complete, the incline was sold for use as a tourist attraction. The railway was abandoned in 1991 after a rock slide damaged it, now it is a popular hiking trail.

When it was built, the plant was the highest head hydro plant in the world, with a total drop of 2,380 feet from the intake to the turbine nozzles. Later in 1907, the head was increased to 2,425 feet when the pipeline was lengthened to Ruxton Park and a new intake built.

In 1965 the New North Slope Line was built from the North Slope Reservoirs on Pikes Peak. The addition of this water source increased the head to 2,656 feet, which produces 1,150 psi of water pressure at the turbines. It is still one of the highest, if not the highest head plant in America. There are two hydro plants in California with heads just as high, the Bucks Creek Plant and Big Creek 2A, both of which were built in 1928.

When built, Manitou had three 750 kW generating units, each had a single 86-inch diameter Pelton turbine with 30 bronze buckets, and a deflecting needle nozzle. The generators produced 60 cycle, three phase AC power at 450 rpm. A Lombard Model F Governor on each machine provided accurate speed/load control. Two small units provided the excitation current, and each of these was powered by a small Pelton turbine.

The Manitou Plant and all of the steam power plants in Colorado Springs at that time came under municipal ownership on July 1, 1925, through a city vote.
In 1927 one of the original units (unit #3) was removed and replaced with a new 2,500 kW machine. This new machine has a 41-inch diameter Pelton turbine spinning a Westinghouse generator at 900 rpm. This new unit (then unit #3, our current unit #2) became the main generating unit for Colorado Springs, and the two older machines kept in reserve for emergencies. The two remaining older units were removed in 1939 and replaced with a new machine nearly identical to the one purchased in 1927. The penstock was also replaced and enlarged from 20 inches to 24 inches in 1939 as well. Portions of the older 20-inch penstock can still be seen if one were to hike the incline.

The plant continued to be operated round the clock by a crew of five until it was fully automated in 1994. Now it is operated remotely from the Birdsall Power Plant.

In late 2005 construction began on a new machine, running on a different pipeline than the older machines. It is capable of generating up to 460 kW, with a 24-inch diameter Pelton turbine spinning an induction generator at 910 rpm. Canyon Hydro out of Deming, Wash., supplied the turbine and control system. Its water source is the Old North Slope line, which comes down Ute Pass from the reservoirs on the North Slope of Pikes Peak with a head of 706 feet. It sits where the original unit #1 sat and uses its old tailrace. This new machine, named Manitou Unit #3 came on line March 15, 2006.

Manitou Hydro, and all of the other hydro electric plants owned by Colorado Springs Utilities, is operated based on water demand, not power demand. In the summer when water demand is higher, the plants generate more power, in the winter they produce less because water demand is lower.
Ruxton Hydro Electric Plant

Even before the City of Colorado Springs had control of the utilities in 1925, plans were drawn up for additional power plants. Two additional plants were designed and built; these were a steam plant downtown (the first two units of what later became the Martin Drake Power Plant), and the Ruxton Hydro Plant. A talented engineering team from Denver, Franklin Wood and Eugene Weber designed and built both of these plants. Wood had worked at the Lake Moraine plant one summer as an operator early in his career.

The original builders of the Manitou Hydro Plant were supposed to build a pipeline from Manitou up to Lake Moraine, but they never did. Once the city planned to take over control of the utilities the remainder of the pipeline was finally built.

The construction of the pipeline began May 27, 1924, and was completed on Oct. 20, 1925. Water was turned on at 11 a.m. on Oct. 19 and the unit was turned for the first time to dry out the generator windings and for testing. The unit generated power for the first time on Nov. 6, 1925.

The Ruxton Plant is unique in that it was the first fully automatic hydro plant of its type in the world. It was designed to be started, stopped and operated from the Manitou Hydro Plant with no human intervention at the plant itself. It was said that one could tell in town when the Ruxton

A view of inside the Ruxton Hydro Plant on Oct. 5, 1925. The plant looks very much like this today.
unit came online due to slight blip in the lights. This was due to the large in rush current of the generator, since it came online as an induction machine and then the excitation was added which pulled the unit into synchronism with the remainder of the power system.

The plant has a capacity of 1,000 kW, with a 51-inch Pelton turbine providing the power to rotate a 6,600 volt, three phase, 14 pole AC generator at 514 rpm. A belt-driven Pelton 0-3 Governor was connected directly to the needle valves for accurate governing. The equipment is housed in an attractive stone powerhouse, constructed of native stone with a red tile roof, built in Ruxton Park next to the Manitou Intake tank, which was built in 1907.

Three miles from Manitou Springs, Ruxton Park was originally planned to be a town site, and a few log cabins were built before the land was acquired by the City of Colorado Springs as part of the South Slope watershed. After the water exits the Ruxton plant through the concrete tailrace, it drops into the Manitou intake tank for its trip down to Manitou Hydro to be used again in the generation of electricity.

For reasons unknown, the original automation components were removed in 1931 and the plant was operated by an operator who lived onsite in the operator’s house. In 2013 the plant was once again automated, remotely monitored and operated from the Birdsell Power Plant. Due to the plant’s historic nature, much of the modern automation equipment and controls are hidden so as to not detract from the plant’s original appearance.

This plant is normally in operation from May to October each year, the rest of the time it is shut down, due to lack of water flow during the winter.
Tesla Hydro Electric Plant

The City of Colorado Springs and later Colorado Springs Utilities did not add any additional hydro power until the Tesla Hydro Plant was built in 1997. It was named after the Croatian born genius inventor, Nikola Tesla who had a laboratory in Colorado Springs in the early 1900s. Tesla is considered by many to be the father of our modern alternating current, three-phase power system.

Located on the Air Force Academy, the Tesla plant is the most modern hydro plant in Colorado. It has a capacity of 28 MW, and is of the European design vertical shaft style. It has a 61.22-inch diameter Pelton turbine, built by Sulzer in Switzerland and it is surrounded by five needle nozzles with deflectors. The generator, which was built by ABB in Brazil, sits above the turbine, and spins at 600 rpm. This unit is much larger than the other hydro electric units in the system; its generator rotor alone weighs 56 tons.

The water to drive this unit comes from Rampart Reservoir, through a completely underground 1,000-foot shaft and three-mile long tunnel, with a total head of 1,715 feet. The tunnel was cut through solid granite with a small tunnel boring machine. The concrete powerhouse was finished with stone to look similar to the Ruxton Hydro Plant.

Remote Energy Plants

The Ruxton, Manitou, Tesla and Cascade Hydro Plants are maintained and operated by a small and unique group inside Colorado Springs Utilities’ Energy Supply Division. In place since 2005, Remote Energy consists of 12 employees; a plant manager, two supervisors, a planner-analyst and eight production team specialists. The production team specialists are all plant operators, but also work as maintenance mechanics, electricians and instrument and control specialists.
Cascade Hydro Electric Plant

Hydropower is a remarkable technology that Colorado Springs’ founding fathers wisely made use of, and some of those plants still produce power today. As today’s focus on renewable energy grows so will the focus on hydro power. It would not be surprising to find additional locations in the Colorado Springs water delivery system to install hydroelectric units and see them built and running in the future.

The Cascade Hydro Plant, rated at 750 kw, consists of a dual nozzle Canyon Hydro 28-inch Pelton turbine spinning a 480 volt Teco-Westinghouse induction generator at 910 rpm. The turbine operates on a head of 1,039 feet, or about 450 psi turbine inlet pressure. The generating unit, bypass valve and controls are all housed in a dark green steel building, made to blend in with the surrounding forest. The water source for the Cascade plant is also the Old North Slope line. In fact, after the water passes through the Cascade Unit, it’s piped to Manitou to spin Manitou Unit #3. The Cascade unit replaces various pressure reducing valves that had been in use at that site since 1932.

Colorado Springs Utilities’ newest hydro electric plant was completed in the town of Cascade, along Ute Pass, and came online Feb. 11, 2010.

The hydro electric plants are not the only assets operated and maintained by this small but skilled group. They are also in charge of the Birdsall Power Plant and the Propane Air Plant.

The Birdsall Power Plant is a three unit, natural gas or diesel oil-fired steam plant capable of generating 56 megawatts of power. It was built from 1953 to 1957 and is normally on standby status, ready to run when needed.

The Propane Air Plant facility is used to supplement the natural gas supply to Colorado Springs on days of high demand or high cost. It mixes compressed air and vaporized propane to make a synthetic natural gas, which is then injected into the city’s natural gas system.