Northwest Natural Gas Company has proposed to convert the Bruer and Flora pools of the Mist Gas Field in west-central Columbia County, Northwestern Oregon, to pipeline gas storage reservoirs. Conversion to underground storage of pipeline gas in these depleted gas reservoirs would be the first in the Pacific Northwest. The Bruer and Flora Pools are fault trapped within the Cowlitz Formation. The shales overlying the Cowlitz Formation create a local seal for these gas reservoirs. X-ray diffraction and density log measurements suggest that the clay in these shales is primarily composed of smectite, which provides an excellent caprock seal.

The reservoir rock of the Bruer and Flora Pools is the arkosic Clark and Wilson Sand. An average weighted grain density for the sand
is 2.65 g/cm³. The abundance of potassium feldspar in the sand, hence K⁴⁰, creates a background gamma radiation for the sand roughly equal to that of the shale, making the sand and shale virtually indistinguishable on the gamma ray log.

Bottom Hole Temperatures (BHT), which were recorded on open hole logs, indicate the Bruer Pool is 7°C (20°F) warmer than the Flora Pool, even though the Flora Pool is deeper. This temperature anomaly may be the result of equipment variation. A calibrated temperature survey would remove any discrepancies. A comparison of the thermal gradient determined in a previous study of the Oregon Coast Range and a gradient determined using BHT, suggest that BHT provide a good approximation of formation temperature.

Utilizing the formation water analysis determined from four different wells in the Mist Gas Field, average total dissolved solids was found to be 24,444 mg/l. Of the four analyses, the sample from Well CC#6 R/D2 is considered to be the most representative of the Bruer and Flora Pools formation waters. Analysis of the four samples using the Palmer System suggests that the formation water of the Cowlitz Formation is in the early stages of sea water diagenesis.

Formation water resistivity (Rw) was determined using a chemical and spontaneous potential analysis. Rw derived using chemical analysis averaged 0.175 ohm-meters and is considered the most precise. Water saturation determined using the Archie saturation equation averaged 47.5% and ranged from 26.4 to 80.0% for the zone 814-836 meters (2670-2742 feet) in CC#10. These results are similar to those determined by the Thermal Time Decay (TDT) log.
Core and geophysical log data from the field are sparse. Porosities were obtained by analysis of sidewall cores from one well in the Bruer pool, but these values are considered too high. Conventional core analyses were also obtained for one well but it is located 5 km (3 miles) southeast of the proposed storage reservoirs. Therefore, porosities had to be derived from analysis of geophysical logs from boreholes within the Bruer and Flora Pools.

The open-hole log suite for the Bruer and Flora pools normally consisted of an acoustic and induction log, however, a neutron and density log were also run on one well in the Flora pool. TDT logs were run on all completed wells. Porosities determined from the acoustic logs are erroneously high since required compaction, residual gas, and shale correction factors can not be determined. Attempts to develop appropriate correction factors were not successful due to cycle skipping. The construction of neutron-density crossplots provided reasonable porosity values. To determine porosity from any well within the storage reservoirs, a multiple regression analysis was performed using the porosity determined from the neutron-density crossplots and resistivities from the induction logs. The cementation factor (m) and an empirical coefficient (a) from the Archie equation were determined to be 2.56 and 0.46, respectively. A maximum deviation of +5.7% and -5.3%, and an average deviation of +1.6% and -1.8% from neutron-density crossplot porosities was determined.

Using the average porosity for the reservoir and backpressure tests, a deliverability analysis was performed to determine the drainage radius and stabilization times. This analysis indicates that
one additional well is required for the Bruer pool and two additional wells will be required for the Flora pool to meet the deliverability required by Northwest Natural Gas Company. By plotting the values for deliverability on a structural map, the location of future wells may be determined.