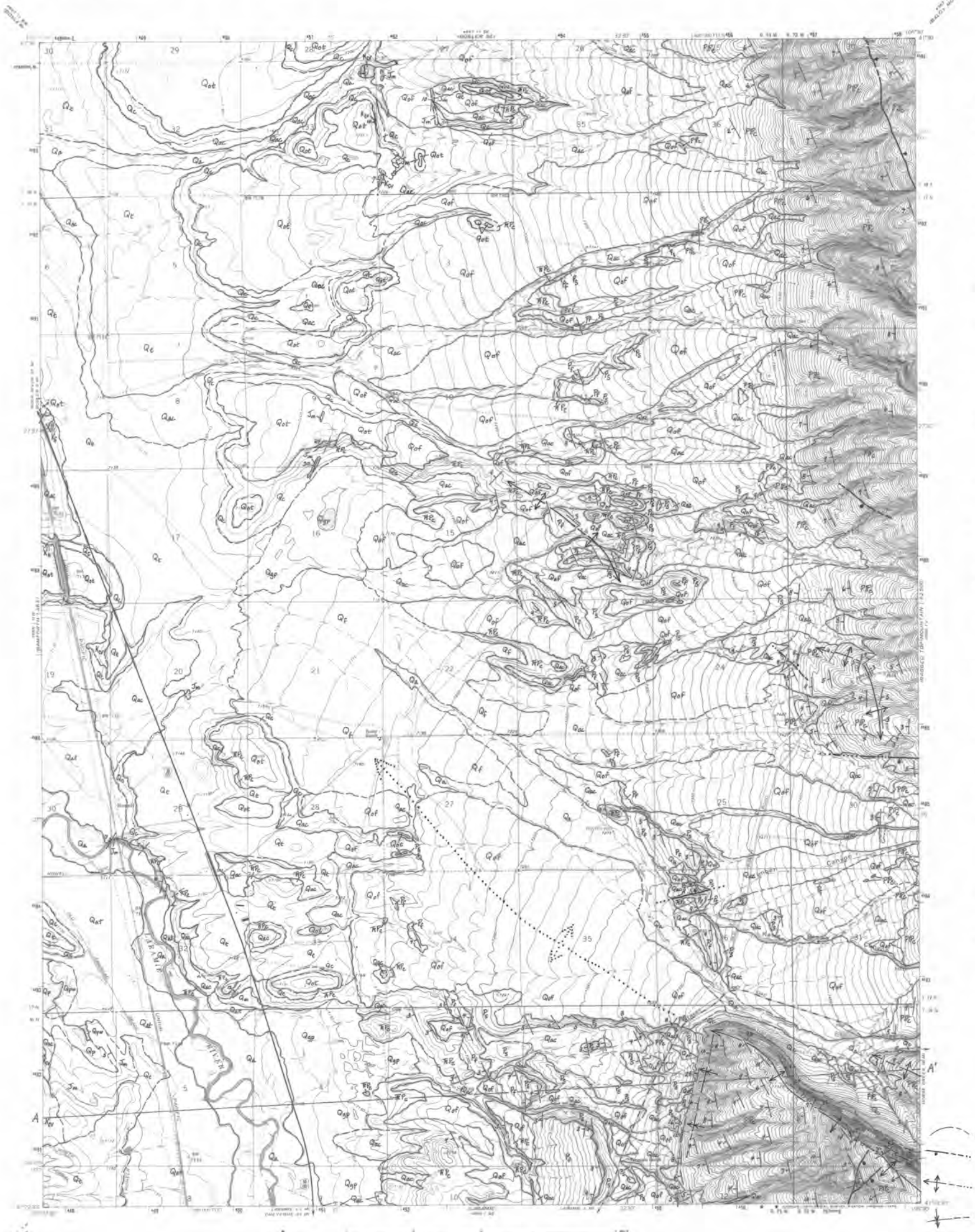


EXPLANATION

SEDIMENTARY ROCKS AND SURFICIAL DEPOSITS

Qa **Alluvial deposits (Holocene)**
Unconsolidated and poorly consolidated clay, silt, sand, and gravel, mainly in floodplains and lowest stream terraces. Thickness 0 to 25 feet.

Qat **Mixed alluvium and terrace deposits (Holocene)**
Unconsolidated and poorly consolidated clay, silt, sand, and gravel, representing a transition zone between alluvium and terrace deposits, mainly adjacent to the Laramie River. Thickness approximately 0 to 30 feet.

Qp **Playa lake deposits (Holocene)**
Clay to silt-sizes stratified lake bed deposits. Thickness generally less than 5 feet.

Qpw **Wind blown playa lake deposits (Holocene)**
Clay to silt-sized lake bed deposits occurring in dunes on the northeast (downwind) side of playa lake beds. Thickness 0 to 15 feet.

Qc **Colluvium (Holocene/Pleistocene)**
Unconsolidated masses of rock fragments and soil material on relatively steep slopes with thickest accumulations at the bases of slopes.

Qac **Mixed alluvium and colluvium (Holocene/Pleistocene)**
Sand, silt, clay, and gravel deposited mainly along intermittent streams; includes slope wash and smaller alluvial fan deposits that coalesce with alluvium. Thickness approximately 0 to 20 feet.

Qf **Alluvial fan deposits (Holocene/Pleistocene)**
Poorly sorted clay, silt, and gravel; crudely bedded to nonbedded. Appear to be active receiving sediments from intermittent streams flowing off of the Laramie Range. May have some debris flow component. Grade into terrace deposits toward west, approaching the Laramie River. Locally, grade into alluvium and colluvium. Thickness approximately 0 to 25 feet.

Qt **Terrace deposits (Holocene/Pleistocene)**
Beds of coarse sand and gravel with occasional boulders and lenses of silt and clay. Includes fragments of weathered granite and limestone cobbles; predominance varies depending on source of feeding stream. Occur along present drainages, a few feet to over 35 feet above modern flood plains. Thickness approximately 0 to 10 feet.

Qls **Landslide deposits (Holocene/Pleistocene)**
Blocks of bedrock or loose slope debris; arrows point in the inferred direction of movement. Occur in the Forelle Limestone; detaching at the contact with the underlying Satanka Shale.

Qgp **Gypsite deposits (Holocene/Pleistocene)**
Unconsolidated clay-sized gypsum interbedded with red clay, sand, gravel, and limestone cobbles. Located in stream valleys immediately west of the Laramie Fault, probably related to erosion of gypsum beds of the lower Chugwater Formation which were brought to the surface or near surface by the Laramie Fault. These deposits were mined for cement plaster near the turn of the century. Thickness 0 to 10 feet.

Qof **Older alluvial fan deposits (Holocene/Pleistocene)**
Poorly sorted clay, silt, sand and gravel; crudely bedded to nonbedded with some debris flow component. Limestone cobbles are common. Currently inactive and dissected, often occurring as erosional remnants. Grade into older terrace deposits toward the west, in the northern part of the map area. Thickness 0 to 10 feet.

Qot **Older terrace deposits (Holocene/Pleistocene)**
Beds of coarse sand and gravel with occasional boulders and lenses of silt and clay. Limestone cobbles are common. Often occur as erosional remnants ranging from 20 to 100 feet above present stream floodplains. Some remnants may actually be older alluvial fan remnants. Thickness 0 to 10 feet.

UNCONFORMITY

Kf **Frontier Formation (Upper Cretaceous)**
Dark gray to black shale with interbedded thin, lenticular, tan to gray sandstones and thin bentonite beds. Persistent tan sandstone occurs at top of formation, locally referred to as the "Wall Creek Sandstone". Thickness approximately 550 feet.

Kt **Thermopolis Shale (Lower Cretaceous)**
Gray to black soft shale with some thin brown to tan sandstones locally interbedded. Ironstone concretions appear in the upper portion of the formation. Fossil fish fragments occur locally in the upper thin sandstones. Selenite crystals are common in outcrop. Thickness 60 to 75 feet.

Kcv **Cloverly Formation (Lower Cretaceous)**
Basal tan to white coarse-grained sandstone and chert pebble conglomerate, locally crossbedded and overlain by varigated buff and purple claystones interbedded with thin black shale beds, and an upper gray to buff to brown, fine- to coarse-grained sandstone, crossbedded in lower portion. Thickness 100 to 130 feet.

UNCONFORMITY

Jm **Morrison Formation (Upper and Middle Jurassic)**
Pale-green, olive-green, blue-green to maroon and chalky white variegated calcareous and bentonitic claystones interbedded with thin drab limestones and buff, non-resistant sandstones. Limestone, locally, contains orange to brown chert inclusions. A thin section of Sundance Formation may exist in the area, but due to few and poor exposures, it is mapped with the Morrison. Thickness 300 to 350 feet.

UNCONFORMITY

TrPc **Chugwater Formation (Triassic and Permian)**
Red shale and siltstone with interbedded red to salmon to buff, fine-grained sandstone. Lower portion of section contains red shale interbedded with thin to thick gypsum beds, local solution breccia, and banded wavy gypsiferous thin limestone sometimes mistaken for part of the Forelle Limestone. This portion of the Chugwater along with the underlying Forelle Limestone and Satanka Shale would be mapped as Goose Egg Formation west of the Laramie Basin. Locally, some possible Jelm Formation sandstone erosional outliers may occur, but due to their lack of persistence they are mapped with the Chugwater. Thickness 650 to 800 feet.

Pf **Forelle Limestone (Permian)**
Gray to purple, thin bedded, sparsely fossiliferous limestone locally interbedded with red siltstone and thin gypsum laminations. Wavy outcrops resembling algal structures common. Landslides are common on Forelle dip slopes with the unit detaching from the underlying Satanka Shale. Thickness 10 to 30 feet.

Ps **Satanka Shale (Permian)**
Red siltstone and shale (often banded with white and ocher color zones), soft sandstone, thin limestones, and local gypsum beds, especially near the top. Buff to orange to red, fine-grained sandstone with ripple marks common near base of unit. Gypsum beds in the Satanka were mined some time after the turn of the century in Section 2, T16N, R73W on this map. Thickness 250 to 300 feet.

UNCONFORMITY

PPc **Casper Formation (Permian and Pennsylvanian)**
Buff to reddish, calcareous to quartzitic, very fine- to coarse-grained, well cemented subarkosic sandstone interbedded with buff to purplish-gray limestone and dolomite beds, usually micritic and locally fossiliferous. Sandstone often exhibits large-scale festoon cross-bedding, increasing toward the south. As many as 10 different limestone or dolomite beds, which are locally quarried for cement or gravel uses, have been identified in the Laramie area. The Casper Formation serves as the prime aquifer in the Laramie area. Intertongues with underlying Fountain Formation, which is less than 50 feet thick, occurring in the subsurface only and pinching out to the north within in the map area. Thickness 600 to 660 feet.

MAP SYMBOLS

Formation contact
Dashed where approximately located.

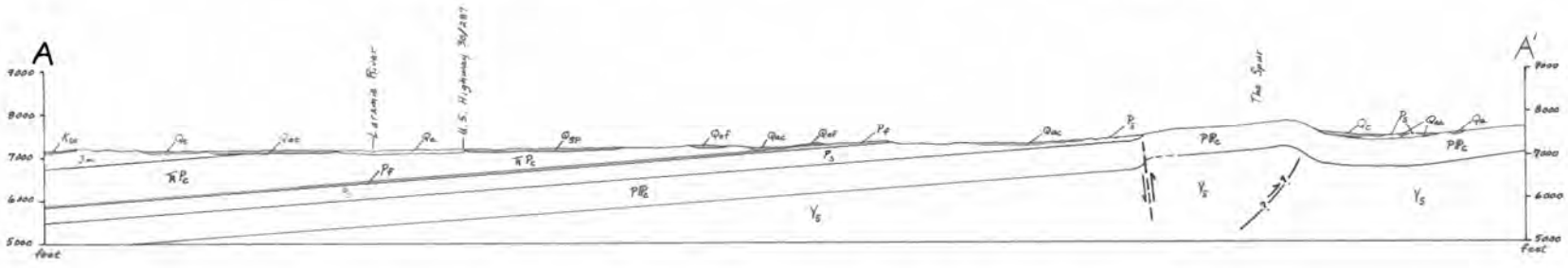
Fault
Dashed where approximately located, dotted where concealed. Bar and ball on downthrown block.

Anticline
Trace of axial plane and direction of plunge determined by field dip measurements and by photo interpretation. Dashed where approximately located, dotted where concealed.

Monocline
Trace of axial plane as determined by field measurements and by photo interpretation. Dashed where approximately located. Short arrow denotes steeper dipping limb.

5 **Strike and dip of beds, showing angle of dip.**

A—A' **Cross section location**
Line of section. Sherman Granite (Middle Proterozoic)-Ys-is shown on the cross section only as it does not crop out in map area. Coarsely crystalline pink granite ranging in age from 1,414 to 1,435 Ma.



PRELIMINARY GEOLOGIC MAP OF THE HOWELL QUADRANGLE, ALBANY COUNTY, WYOMING

by

Alan J. Ver Ploeg

1996

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WYOMING STATE GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE HOWELL QUADRANGLE, ALBANY COUNTY, WYOMING

by

Alan J. Ver Ploeg

PRELIMINARY GEOLOGIC MAP
96-1

Laramie, Wyoming
1996

Overview of the Preliminary Geologic Map of the Howell Quadrangle, Albany County, Wyoming

Introduction

The Preliminary Geologic Map of the Howell Quadrangle is part of a new series of 1:24,000-scale geologic maps developed to aid citizens, county and city planners, and local industry in incorporating basic geologic information into their planning and development efforts. This project emphasizes creating geologic maps at a detailed scale of the more populated areas within the State of Wyoming. The map provides information relating to mineral resources, groundwater resources, potential geologic hazards within the map area, and structural geology as it may relate to development and planning within the mapped area.

Mineral Resources

Mineral development within the Howell Quadrangle centers primarily around sand and gravel production, some limestone production, and, historically, gypsum and building stone production. Sand and gravel mining is typically associated with the Quaternary units mapped on the quadrangle, including but not restricted to alluvial deposits, mixed alluvial and colluvial deposits, mixed alluvial and terrace deposits, terrace deposits, and older terrace and alluvial fan deposits. Currently and recently active operations occur in older alluvial fan deposits northeast and northwest of The Spur, in the southeast portion of the quadrangle. Additional active and recently active quarries occur in mixed alluvial and colluvial deposits and terrace deposits in the southwest portion of the quadrangle, on the east side and adjacent to the Laramie River.

Limestone production is restricted to the limestone units in the Casper Formation which crop out on the east side of the mapped area, on the flanks of the Laramie Mountains. The limestone is mined for road gravel, other types of construction aggregate, and cement production needs. Historically, quarries have existed in numerous locations along the Laramie Mountains, east of the city of Laramie. Within the Howell Quadrangle, one recently active quarry exists on the east side of The Spur.

Near the turn of the of the century, gypsum was mined from the gypsite deposit in south Laramie, immediately north of present-day I-80. The gypsum was used in plaster production. The sources for the gypsite deposit were the gypsum beds in the lower Chugwater Formation which were brought to a near surface position by the Laramie fault and subjected to Quaternary erosion. Within the Howell Quadrangle, an extensive gypsite deposit occurs within Section 4, T.16N., R.73W., just east of the Laramie River. This deposit, which is sourced by gypsum beds in the Chugwater Formation to the east, shows no evidence of having been mined to date. Bedded rock gypsum, some of which is alabaster, occurs in a 9 foot bed within the upper Satanka Shale croppingout west of The Spur, in a SW1/4 of Section 2, T.16N., R.73W. Limited mining of the deposit by Monolith Portland Cement Company occurred in the 1950's.

Historically, sandstone from the Casper Formation was quarried for building stone at the mouth of Rogers Canyon, immediately adjacent to the quadrangle on the southeast corner. Several buildings on the University of Wyoming campus, were built with sandstone from this quarry. This same quality sandstone unit occurs in the eastern portion of the quadrangle.

Groundwater Resources

The Casper Formation is the principal aquifer supplying water for municipal and private/domestic needs within the quadrangle. The formation consists of alternating sandstone and limestone, with the permeable sandstone serving as the aquifer and the limestones, unless highly fractured, serving as impermeable confining units. The Casper produces excellent water with low dissolved solids and excellent flows. The important recharge area for the Casper Formation is in the eastern part of the quadrangle on the flanks of the Laramie Mountains. In addition, some shallow wells produce from alluvial deposits and mixed alluvial and terrace deposits adjacent to the Laramie River. Other local aquifers of lesser importance include thin basal sands in the Satanka Shale, fractured limestone in the Forelle Limestone, sands in the upper Chugwater Formation, and, in the northwest part of the quadrangle, the Cloverly Formation. These aquifers, with the exception,locally, of the Cloverly Formation, produce poor quality water, high in total dissolved solids with very limited flow potential. Wells producing from these aquifers are used primarily for livestock watering.

Potential Geologic Hazards

Potential geologic hazards within the Howell Quadrangle are related to the Quaternary gypsite deposits, potential debris flows, and potential landslides in the Forelle Limestone. A gypsite deposit occurs east of the Laramie River in the southwest corner of the quadrangle as noted in the mineral discussion above. The deposits occur as a result of Chugwater Gypsum beds being subjected to Quaternary erosion and concurrent mixing with sediments from the east. The high solubility of the gypsum in these deposits make them quite susceptible to the formation of cavities and local resultant collapse features. High amounts of gypsum in the soil can inhibit plant growth and can react with untreated concrete causing disintegration. The location of this gypsite occurrence definitely needs to be considered in any plans for development within affected areas.

A small landslide was mapped immediately north of The Spur in the Forelle Limestone. The slide occurs at the contact between the Forelle Limestone and the underlying Satanka Shale. This slide appears to be quite old and the potential for new slides is probably rather remote. However, the Forelle could detach given the right combination of conditions including unusually wet weather, a steep dip slope, and, for example, removal of the toe of a slope. Consideration of this potential should be included in planning for development on or near Forelle outcrops with these characteristics.

Debris flow potential exists along the margins of mapped older alluvial fan and alluvial fan deposits. These areas become especially vulnerable during periods of abnormally high precipitation. This potential hazard should be considered in planning for development near these types of deposits.

Structural Geology

Rock units on the Howell Quadrangle have a regional dip to the west off of the Laramie Mountains, of approximately 4-8 degrees, striking nearly north to south, to slightly northwest. This regional trend is interrupted locally by faulting and folding. Folding is in the form of mostly northwest and north trending anticlines and a monocline which plunge toward the northwest and were formed by northeast directed compressional forces. Three previously unmapped anticlines were identified in the eastern portion of the quadrangle, east and north of The Spur. The anticline that forms The Spur and the one immediately to the east are excellent examples of these types of structures. The Spur anticline is asymmetrical with the steep limb in the northeast side and includes a monocline on the west side, probably reflecting a fault at depth. This anticline is probably cored with a reverse fault. The Spur anticlinal trend is projected toward the northwest where is it is concealed by Quaternary deposits.

A limited number of minor faults occur on the quadrangle, probably relating to the northeast directed compressional forces which formed the folds noted above. However, additional more significant faulting may exist on the western half of the quadrangle relating to the concealed structures. For example, the Laramie fault which was mapped on the Laramie and Red Buttes Quadrangles, may extend into the western portion of the Howell Quadrangle. Linears noted on the airphotos seem to support this, but poor bedrock exposures and extensive Quaternary cover in this portion of the map make it difficult come up with hard evidence for extending this fault. A consideration of the structural features noted on the map, as well as those inferred will be instrumental in planning for development in the area and searching for good sources for municipal and private water supplies. This is especiallly true for the Sunset Acres and Rocky Top Ranch housing subdivisions near The Spur and the Aliquot subdivision east of the Laramie River in the southwest portion of the quadrangle.