

## Weight Limits

Bonner County's extensive road system is a lifeline for our residents and our local economy. Farms depend on these roads to transport forest and agricultural products, contractors need them to move equipment and materials to and from job sites and residents rely upon them for access and services throughout the year. However, heavy truck loads can damage local roads in the spring when they are weakened because they are saturated with water.

Bonner County roads are north of the 40<sup>th</sup> parallel and therefore in a region that experiences a freeze-thaw environment. Frost action alone can create several damaging effects to roads with frost heaves but an equally serious problem is the loss in the ability of the road base to support heavy loads during periods of thaw. Load restrictions are typically used as a preservation strategy by road authority agencies during late winter and early spring as well as during warm weather periods in the mid-winter months. Bonner County established the current frost law, weight and hauling limits in BCRC Title 2, Chapter 3 through the following ordinances:

- Adopted Ordinance 236 (1/29/1994)
- Ordinance 329 (1/22/1997)
- Ordinance 368 (1/22/1999)
- Ordinance 422 (3/12/2002)

When weather turns cold for an extended period of time the moisture in the roads begin to freeze near the surface and as cold temperatures persist through winter the frost line can extend down below 2 feet or more. During periods of warmer weather, the roads begin to thaw from the top down and the bottom up. As the road structure thaws a depth of 6 to 12 inches from the surface, the water from the melting ice is unable to drain into the frozen subgrade below. These layers lose strength and weaken considerably in a short time under these conditions. The weakness can continue for weeks or months after the surface appears to be completely thawed as it takes a long time for water to leave frost-susceptible silt and clay soils, which are relatively slow to drain.

In the 1980's the Washington State Transportation Center (WTSC) in cooperation with several other agencies began to study this effect and develop guidance for addressing the problem. They determined that passenger vehicles and light duty vehicles were not the problem, rather heavy truck loads traveling over the weakened surface. The studies found that as the axle weight increased on the weakened roads the resulting damage increased at a faster rate. For example, a 9-ton axle load can cause about 10 times more damage than a 5-ton axle load. Therefore, a weight or load reduction during this critical period will extend the life of the roads, as shown below:

| Pavement Load Reduction (%) | Pavement Life Increase (%) |
|-----------------------------|----------------------------|
| 20                          | 62                         |
| 30                          | 78                         |
| 40                          | 88                         |
| 50                          | 95                         |

It can be difficult to predict when the dates for spring thaw will begin and for how long weight limits should be in place. However, the most critical time for placing the spring load restrictions appears to be when the pavement structure has thawed to a depth of 6 to 12 inches from the surface of a road on any portion of the road. The following tools are helpful in determining when to apply load limits:

1. **Local Experience.** The foreman for each road district in Bonner County has experience observing conditions in the field relating to potential weakening during the thaw period. Observations of poor drainage from side ditches, pavement distresses in the form of cracking and rutting, high groundwater tables, winter precipitation and resistance to driving metal sign posts are examples of information gathered in the field to assist in the determination of when to place the spring load restrictions.
2. **Air Temperature Data.** Recording information regarding air temperature data collected at various airports within Bonner County can be analyzed to determine the extent of freezing resulting from the cumulative effects of average day air temperatures below 29 degrees and predicting the extent of the thaw when average day air temperatures exceed 32 degrees. Incorporating forecasted weather data into the model can be used to predict changes as well as estimation on the time required for complete thawing to occur. This process is outlined in a publication by the University of New Hampshire Technology Transfer Center titled "Guidelines for Spring Road Use Restrictions."
3. **Frost Probes.** Frost probes placed beneath the road surface can be monitored throughout the winter and provide a glimpse as to the temperatures below the road surface. A few frost probes had been placed in various locations throughout the County. Only one frost probe remains functional today on the Dickensheet Road near Priest Lake and can be used to provide additional information. Typically, conditions along a road can vary due to areas of shade versus areas open to the angle of the sun and the frost probes only provide information relative to the location of the frost probe installation.
4. **Falling Weight Deflectometer.** A falling weight deflectometer is a device that can be used in the field to measure the elastic modulus (stiffness) of the layers of a road, including sub-grades, sub-base and base courses and pavements. Purchasing a device, training staff to use the device and calibrating the device to be used at specific locations throughout the County would require additional funding which is currently not available to the Bonner County Road and Bridge Department. Portable falling weight deflectometers have been developed to reduce these costs but still require detailed calibration and consistency to provide beneficial information. At this time, neither the regional Idaho Transportation Department nor Bonner County owns this type of device.

Once the decision is made to apply the load limits, it is typical to keep weight restrictions in place until the soils are completely thawed and drained to normal moisture levels which can average between 12 and 13 weeks in Bonner County. If the restrictions are removed during a temporary re-freeze event, the potential for pavement damage exists as excess moisture can be trapped between the thin frozen surface layer and the still frozen deeper soil layer. Since the County does not have a falling weight deflectometer, the most economical way to determine when to remove weight restriction is through the

combination of judgment, experience and estimations based on a thawing index generated with air temperature data.

Ordinance 422 does provide the following exception:

“During times of extreme cold weather, some roads may be opened for early morning hauling, at the direction of the public works director. It shall be the responsibility of the hauler to contact the public works department to determine whether or not these modified restrictions are in place.”

A list of other exceptions to weight limits are provided in Ordinance 422 but essentially allows emergency vehicles and school buses to operate during this time while essential haulers (heating fuel, septic pumping, feed providers and garbage trucks) are allowed to haul half loads by permit obtained through the Bonner County Public Works Department. Special permits or single haul permits are not allowed by ordinance in an effort to treat all haulers equally.

Protecting the local roads from damage by heavy vehicles is the responsibility of Bonner County. The cost to build or reconstruct all roads to a 10-ton year round capacity would be extremely expensive and the financial resources simply do not exist in Bonner County. In establishing weight limits to extend the life of the roads, Bonner County must incorporate judgment, common sense and affordable methods to balance the need for protecting roads with maintaining commerce and an efficient transportation system.