

USGA - CART DAMAGE DEFINED

Several studies have analyzed the turf damage caused by golf carts and other turf vehicles. The impacts can be broken down into two broad categories:

- Turf injury - The wear damage caused by vehicles is influenced by the speed of travel and the amount of stopping, starting, and turning. The tread design of tires also affects wear damage. Wear symptoms include leaf tissue matting and a subsequent exposure of underlying thatch. With additional traffic, leaf blades are bruised. Ruptured cells eventually give turf a dark, water-soaked appearance. Wilt sets in as water is lost from the leaves, eventually causing a loss of chlorophyll and cell death.
- Soil compaction - The soil compaction caused by carts reduces the shoot growth rate and the recuperative potential of turfgrass. Compaction reduces air and water porosity within the soil as well as water movement through the soil profile. Soil compaction can impact turf growth for several weeks or months, resulting in the total loss of turf cover and chronic problems with poor drainage and the invasion of weeds that prefer compacted soil conditions. There are other variables, such as soil type and moisture levels, that further impact wear stress.

Research by Carrow and Johnson noted that turfgrass growing on sandy soils and some clay soils is more prone to wear injury. Soil compaction is A well-designed cart path that is easy for golfers to follow with routing and curbs for traffic deflection will reduce turf damage significantly.

NOVEMBER-DECEMBER II COMPACTION

All forms of traffic cause some degree of compaction. This is typically an indirect problem greatest when traffic is imposed over excessively wet soils. Any factor reducing turf growth rate, such as soil compaction, high external salt levels, and frozen soils causes a further increase in wear damage compared to a vigorously growing turf.

One golfer per cart impacts approximately the same area as two golfers per cart. Two carts with one golfer in each cart potentially will impact twice the area compared to two golfers in one cart. commonly resulting in a reduction in turf vigor. The forces that contribute to compaction include the weight of the golfer or golf cart spread over the turf surface.

The following example illustrates the amount of pressure exerted on the turf from various sources:

- 200-pound golfer heel of foot (walking) = 25 pounds per square inch (psi)
- 200-pound golfer ball of foot (walking) = 16.6 psi
- 200-pound golfer full foot (standing) = 10 psi
- 200-pound golfer both feet (standing) = 5 psi
- Pull cart (17 pounds) 2"-wide tires = 2.1 psi (two tires)
- Pull cart (17 pounds) 3"-wide tires = 1.4 psi (two tires)
- Pull cart (17 pounds) 4"-wide tires = 1.1 psi (two tires)

- Electric golf cart (empty, 950 pounds) with four 8"-wide tires = 3.7 psi
- Electric golf cart with one person and gear (1,200 pounds) = 4.7 psi
- Electric golf cart with two people and gear (1,450 pounds) = 5.7 psi
- Maintenance pickup truck (3,000 pounds) = 25 psi (four tires) Based on compression pressure; we would expect to see walking golfers causing the most damage. In fact, the majority of wear damage observed in the field is caused by four-wheeled motorized golf carts. Why is this true? Read on!

AREA IMPACTED -WHERE THE RUBBER MEETS THE ROAD

The damage caused by various modes of transportation can be estimated by measuring the contact area of shoes or tires and multiplying this over the total area covered during a round of golf.

The following example illustrates the average area impacted while playing a 6,200-yard golf course:

- Walking golfer with golf bag = 1,283 sq. ft.
- Walking golfer using a pull cart with 3"-wide wheels = 12,908 sq. ft.
- Golfer riding a golf cart = 61,845 sq. ft.
- Two golfers each using a golf cart = 123,690 sq. ft.

Looking at the numbers, it is easy to understand why four-wheel golf carts impact (and compact) the golf course so dramatically. LESSONS LEARNED The preceding examples paint a clearer picture of why golf carts cause significant damage to golf 12 GREEN SECTION RECORD courses. By analyzing the numbers, we can learn the following lessons:

- All vehicles cause turf damage. This includes motorized golf carts, pull carts, and maintenance vehicles. Some of the damage may not be visible for days or even weeks as a result of the effects of soil compaction.
- Walking the golf course and carrying your clubs impacts the golf course far less than pull or motorized carts based on the total amount of area impacted.
- Pull carts impact the golf course less than motorized carts, but all carts impact the golf course more than walking. This is due to the smaller area contacted by foot traffic and the wheels of the pull cart.
- Vehicle traffic has the greatest impact on wear and soil compaction due to the amount of area covered and the increased damage caused by repeated traffic over a concentrated area. Damage is further increased with a greater number of turns, a higher speed of travel, and the number of traffic passes over a given area. Based on the research results, the main focus for minimizing the damage caused by golf carts should be on spreading traffic over a wider area or restricting golf carts to paths.
- There is some evidence to suggest that the newer designs of golf carts can reduce the overall impact on turf injury due to wider tires and smoother tread design.