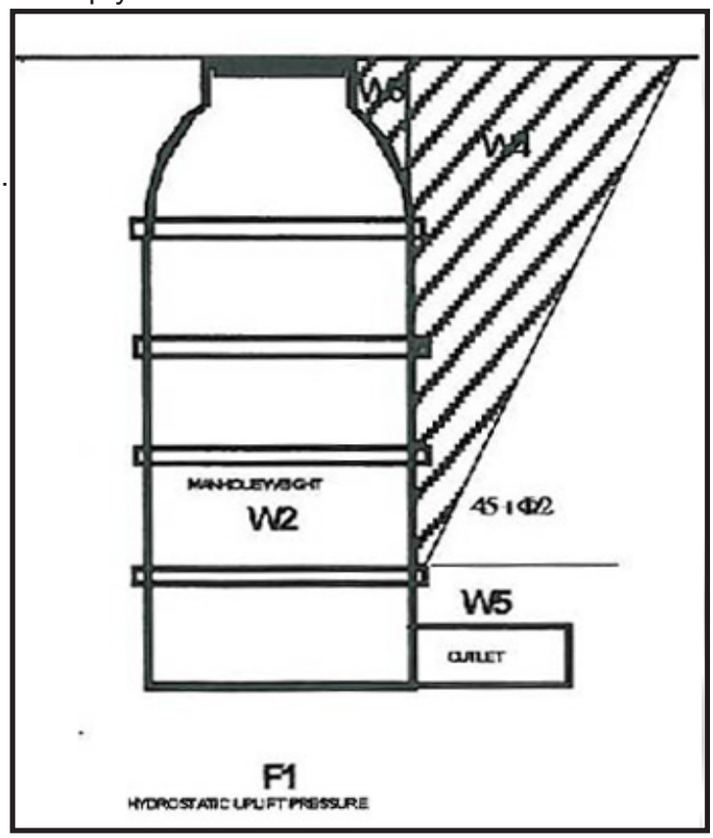
MANHOLE FLOTATION RESISTANCE

EXAMPLE CALCULATIONS FOR MANHOLE FLOTATION:

Assume a 10ft. high Rhino Manhole is installed and backfilled with granular soil. Although it is highly unlikely to occur, we will assume a worst case condition, i.e., groundwater table is up to the top of the lid and the manhole is empty. The dimensions of the example unit are:

B = 49in. = Outside diameter of manhole.
Bs = 54in. = Outside diameter of stiffener ring.
Bc = 28.75in. = Outside diameter of cylindrical section of top.
Hc = 11.5in. = Height of cylindrical section of top.
Hs = 24.5in. = Height of spherical section of top.
Ht = 36in. = Total height of top section.
He = 24in. = Height of cylindrical elevation section.
Hb = 36in. = Height of base section.



Cross-section of Rhino Manhole showing all forces and weights actin for or against flotation.

STEP NO. 1 DETERMINE UPLIFT FORCE, F1:

Hydrostatic pressure at depth 10ft = 624lb/sq.ft.
Area of Base = 13.1sq.ft
Total uplift pressure, F1 = 8172lbs.

STEP NO. 2 DETERMINE WEIGHT, W2, OF MANHOLE:

a. Concrete filled lid =	226lbs.
b. 3ft. high top section =	150lbs.
c. 2ft. high elevation section =	128lbs.
c. 2ft. high elevation section =	128lbs.
d. 3ft. high base section =	130lbs.
Total manhole weight =	762lbs.

STEP NO. 3 DETERMINE WEIGHT OF SOIL, W3, ABOVE MANHOLE SHELL:

Use gravel or crushed stone. Unit weight of soil is 125lb/cu.ft. Buoyed unit wight is 62.6lb/cu.ft.
Volume of soil in 49in. outside diameter cylinder, W3, less total volume of top section = 12.54cu.ft
Weight of soil, W3, is 785lbs.

STEP NO. 4 DETERMINE WEIGHT OF SOIL WEDGE, W4, ABOVE LOWER RING:

Use gravel or crushed stone. Unit weight of soil is 125lb/cu.ft. Buoyed unit weight is 62.6lbs/cu.ft.
Volume of soil in truncated cone less volume used in Step No. 3 = 464cu.ft.
Weight of soil, W3, is 29046lbs.

STEP NO. 5 DETERMINE WEIGHT, W5, TO SHEAR OUTLET AND INLET PIPES:

Although the shear force required to shear the outlet and inlet pipes can be several thousand pounds, that force has been ignored for this example.

SUMMATION OF FORCES, RESISTING - UPLIFT:

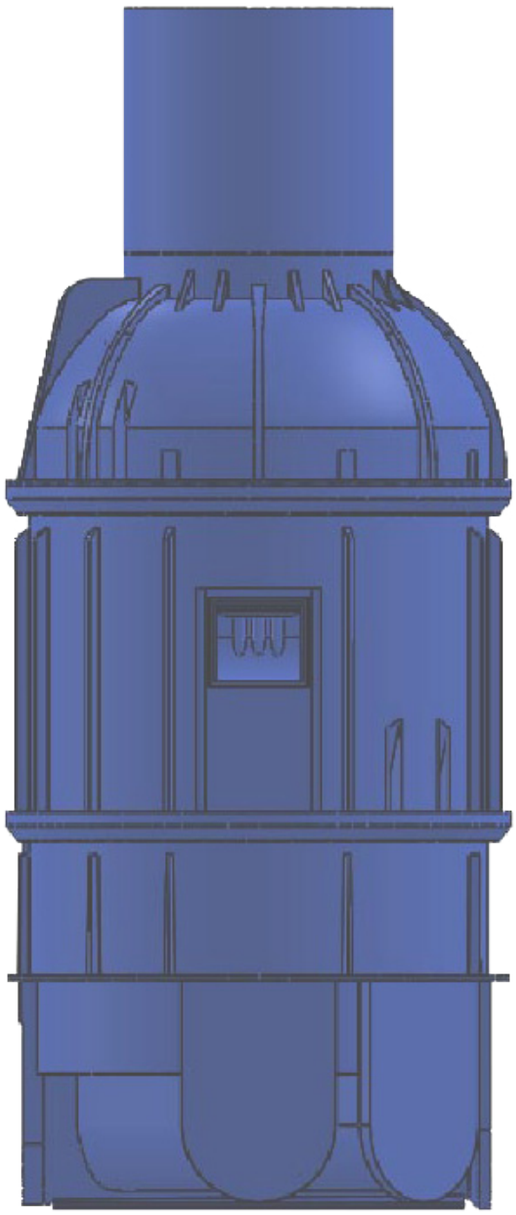
Total of resisting forces, W2 + W3 + W4 + W5 =	30593lbs.
Total uplift force, F1 =	8172lbs.
Factor of Safety =	3.74

RHINO MANHOLES by FIBERTECH PLASTICS

MANHOLE FLOTATION RESISTANCE

Buried hollow structures, such as plastic and concrete manholes, have a tendency to float out of the ground under high groundwater conditions. Any buried hollow structure must be designed and installed to resist potential flotation forces.

The Rhino Manhole can withstand very high groundwater tables, primarily due to a unique stiffening/anti-flotation ring that has been incorporated into the Rhino Manhole design.



There are many factors involved in resisting the flotation forces on a buried Rhino Manhole. Each of the following forces or weights act together to keep the manhole from floating out of the ground:

1. Hydrostatic pressure, F1, from the groundwater acts upward on the bottom of the Rhino Manhole, attempting to push it out of the ground.
2. The weight of the manhole and lid, W2, act downward.
3. The weight of the (buoyed) soil, W3, directly above the dome also acts downward.
4. Each Rhino Manhole component, except the base, has a stiffening ring around the circumference of the manhole shell. The 2.5” wide rings cause each manhole section to behave like an earth anchor, pushing against a wedge of soil, W4, extending outward from the manhole. The angle that the cone makes with the horizontal ring depends on the type of backfill used. In general, any gravel or crushed stone will result in an internal friction angle of 28° to 36°. This is valid unless very loose sands or silts are used as backfill. As a general rule, any clean, granular, compacted soil (coarse sand, gravel, crushed stone) will have a friction angle of at least 30°. This analysis is valid for depths to bottom ring not exceeding 4 manhole diameters.
5. The outlet and inlet pipes will resist the upward hydrostatic force with a force, W5, against the soil. The maximum value of W5 is the force required to shear or break the pipe.