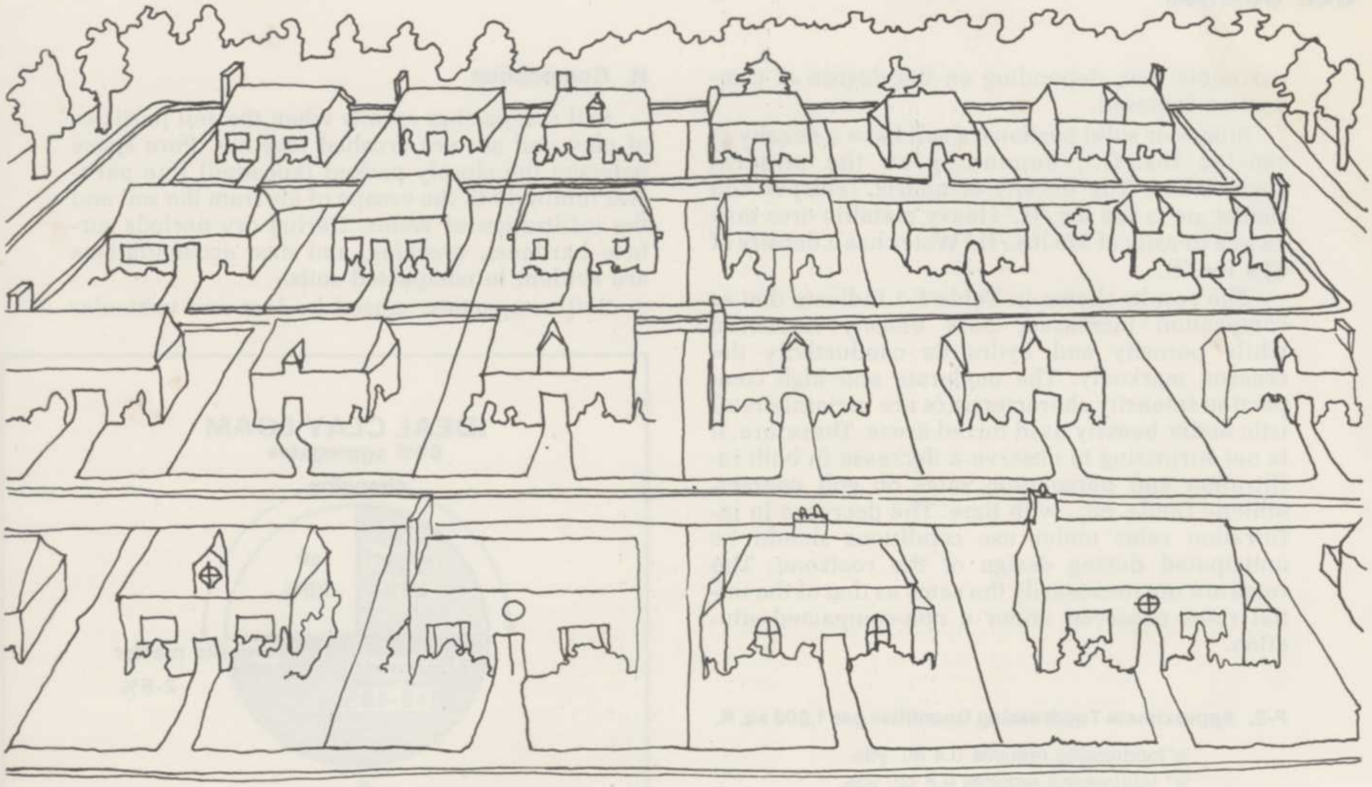


Your lawn service can really grow with Nitroform.®

If you run a lawn service, you can expect to grow faster than grass after a May shower. As cost for seed, fertilizer, chemicals and equipment continue to go up, home owners are looking for a way out. They learn quickly that a lawn care service can do the job for less with guaranteed results. This means increased demand for your services.

As you grow, you need the most efficient technology. That's where Nitroform® slow-release nitrogen can help. It fits the economics. It's also the best way to apply long-lasting nitrogen... whether your equipment is for liquid or dry application. Nitroform is available as granular Blue Chip® or as Powder Blue™ sprayable slow-release nitrogen. Nitroform gives uniform coverage, and it's compatible with most other lawn care materials, including pesticides.

Nitroform is the quality slow-release nitrogen. It keeps feeding long after your crew has moved to other jobs. It's nonleaching... nonburning. Even inexperienced labor can apply it.

Predictable performance... easy application... dependable results. That's Nitroform. For more information, write Agricultural Chemicals, Hercules Incorporated, Wilmington, Delaware 19899. Phone: 302/575-5000.

For Quality Nitrogen
NITROFORM™

HERCULES INCORPORATED

STH-78-5

per cubic foot, depending on the degree of compaction imposed.

Stones or solid portions of soil have a density of 166-172 lbs./ft.³, depending on the mineral composition. The density of quartz, feldspar and sandstone is 166 lbs./ft.³ Heavy metallic ores may have a density of 370 lbs./ft.³ Water has a density of 62.4 lbs./ft.³

The results shown in Table F-1 indicate that as compaction increased, bulk density increased while porosity and hydraulic conductivity decreased markedly. The moderate and high compaction intensity characteristics are certainly realistic under heavily used turfed areas. Therefore, it is not surprising to observe a decrease in both infiltration and percolation rates on golf courses, athletic fields, etc., with time. The decrease in infiltration rates under use conditions should be anticipated during design of the rootzone. The rates are not necessarily the same as that of the initial rates observed under a non-compacted situation.

F-2. Approximate Topdressing Quantities per 1,000 sq. ft.

⅛"topdressing requires 0.4 cu. yds.
¼" topdressing requires 0.8 cu. yds.
1" soil layer requires 3.1 cu. yds.
12" soil layer requires 36.7 cu. yds.

F-3. Weight of Soils and Materials

Material	Condition	Weight per cu. yd. lbs.*	Weight per sq. meter kg
loam	loose	2200	1320
loam	compact	2550	1530
clay	compact	2700	1620
clay	wet	3050	1830
clay sand	compact	3250	1950
silty sand	wet	3100	1860
sand	dry	2700	1620
gravel		3450	2070
crushed stone		3600	2160
peatmoss	compact	450	270
peatmoss	loose	110	66
water		1690	1000

*Factor used is 0.6

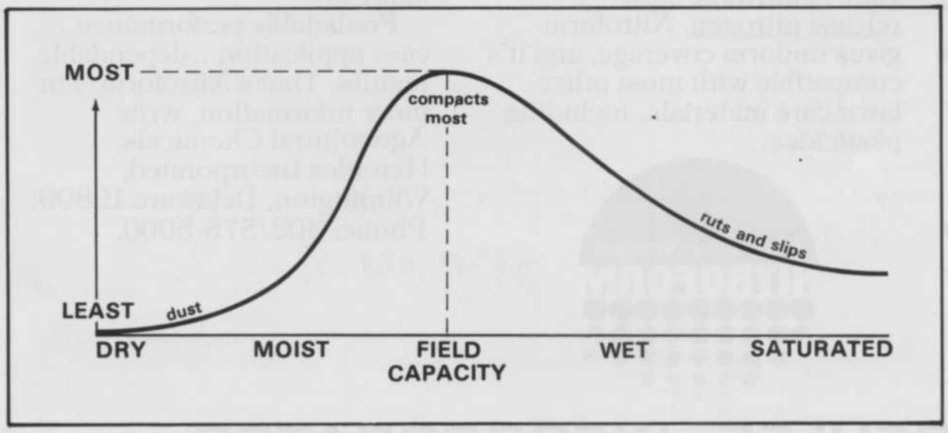


Figure 4: Most compaction occurs when the soil is at field capacity of water.

H. Compaction

Soil compaction results when the soil particles of clay and silt are crushed together. Pore space between the closely packed (kneaded) fine particles inhibit both the escape of air from the soil and the infiltration of water. During dry periods surface hardness, cracking, and dust accumulations are evident in compacted soils.

Soil compaction caused by foot and vehicular

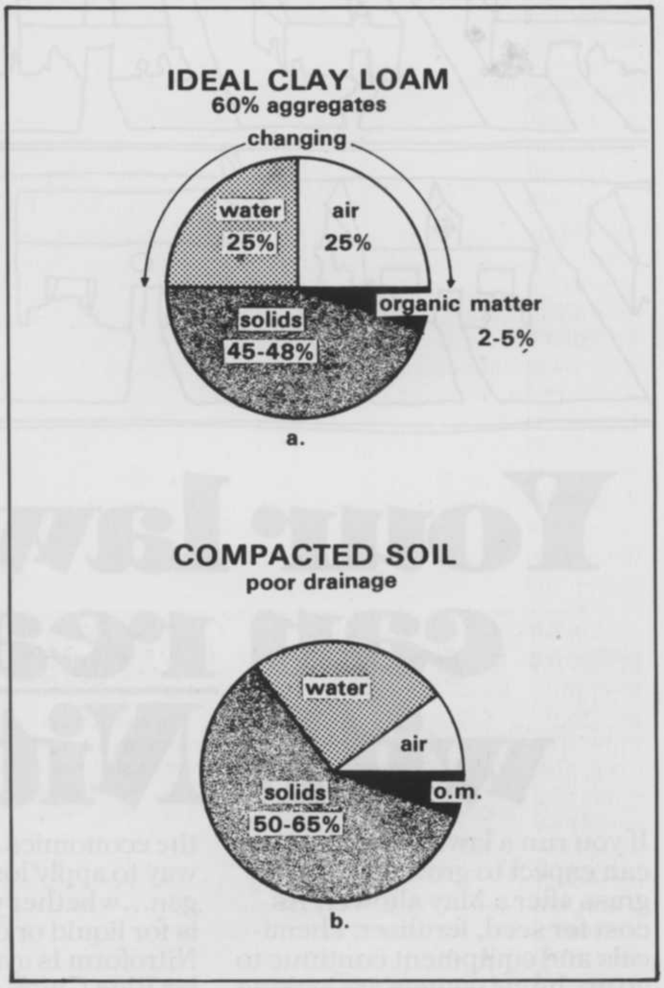


Figure 3: Circle graphs showing reduction in soil gases in compacted soil.

traffic is a common problem of turfgrass areas. As compaction develops, turfgrass loses vigor and density, and root growth becomes restricted because of the low oxygen supply. Table Fig. H-2 illustrates the effect of compaction in reducing non-capillary porosity in a specific soil test. The

H-2. Effect of Foot Traffic on Top Inch of Soil

Compaction	Infiltration per hour	Run-off of rain water	Non-capillary Porosity-volume
	inches	%	%
none	1.5	0	33
moderate	.7	52	19
heavy	.3	76	6

rate of oxygen diffusion is drastically reduced when only 6% non-capillary pores are present, for these may be isolated rather than continuous.

In a nine year study of compaction the air porosity decreased from 21 to 17%, while infiltration was reduced from 45 to 32 cm/hour. Heavy compaction caused a 22% lower air porosity and a 46% lower infiltration rate when compared to normal maintenance for a putting green in Virginia, 1966-74.

The finer soil particles exert more influence on soil characteristics due to their greater surface area compared to larger particles. (Fig. 4) Particles two grades smaller in textural size will pack the available space within the larger fraction. Thus 70% coarse sand combined with 30% fine sand has the drainage characteristics of fine sand.

A compacted mixture composed of 25% (weight) particles of silt and clay can effectively fill all large pores. Because of the large number of particles, the finest 10% of the soil dominates over the 90%. The 90% will have variation, which lends some effects in distribution, but the finer particles, whether mixed by nature, by cultivation or com-

H-4. Correlation of Putting Green Condition With Oxygen Diffusion Rates at Different Soil Depths

Depth	Oxygen Diffusion Rate*		
inches	good	declining	bad
2	52	15	10
4	27	15	10
12	4	4	?

*Measured in grams per square centimeter per minute (average for 20 measurements). An oxygen diffusion rate value of 20 is considered the critical level. Values below this figure will not support satisfactory growth of grass roots.

paction, will control the pore sizes or openings and thus the movement of water and air. The coarsest particles, being large and solid, actually add more interference than if only small particles were present.

The composition of some soils can be compared to that of concrete where gravel particles, sand, cement and water are combined so that each particle settles against and between others. The density of concrete is approximately 2.4, while the density of compacted soil mixtures ranges from 1.3 to 1.7. (See F-1).

I. Pore Space

One of the long standing practices of turf care has been the use of topdressing. Equal portions of sand, soil and peat have traditionally been used. More recently, turf managers have been increasing the proportion of sand in the mixes for topdressing.

The impact of traffic and compaction on pore space in soils should not be underestimated. The initial appearance of a topdressing mixture is altered by compaction as its structure is destroyed and only the texture contributes to pore space. The combination of topdressing components which provides the least pore space after compaction is called the "threshold proportion."

Spomer of Illinois reports 37% pore space of a compacted (single sized) monotextured particle rootzone. A graded mixture of sizes usually contains less than 27% pore space. The "threshold" value of mixes tested was 18% pore space. The mix was comprised of 100 parts sand and 36 parts "soil" mixed and compacted. Each sand and soil varies in proportions required to achieve threshold values.

An interesting fact is the pore space remaining when the sand particles are pushed together by compaction. Uniform size spheres (i.e. marbles) will have 44% pore space. Naturally occuring sand includes a variety of particle sizes. A sample of medium sand had 37% pore space. A mixture of all sizes of sand (good for making mortar) has approximately a 27% pore space. Sand diluted with silt and clay can have as little pore space as 18%. Understanding these relationships increases the appreciation of the variation found in sand and soil rootzones for turfgrass production.

The natural process of wetting and drying, freezing and thawing, granulation and compaction, root production and decay, percolation and leaching, interact with the soil mass as a continuing part of the dynamic soil process. Management programs may include mechanical cultivation to counteract compaction, sand additives to improve infiltration and earthworm activity to dilute thatch. In principle, water and air should freely go into and out of a rootzone. **WTT**

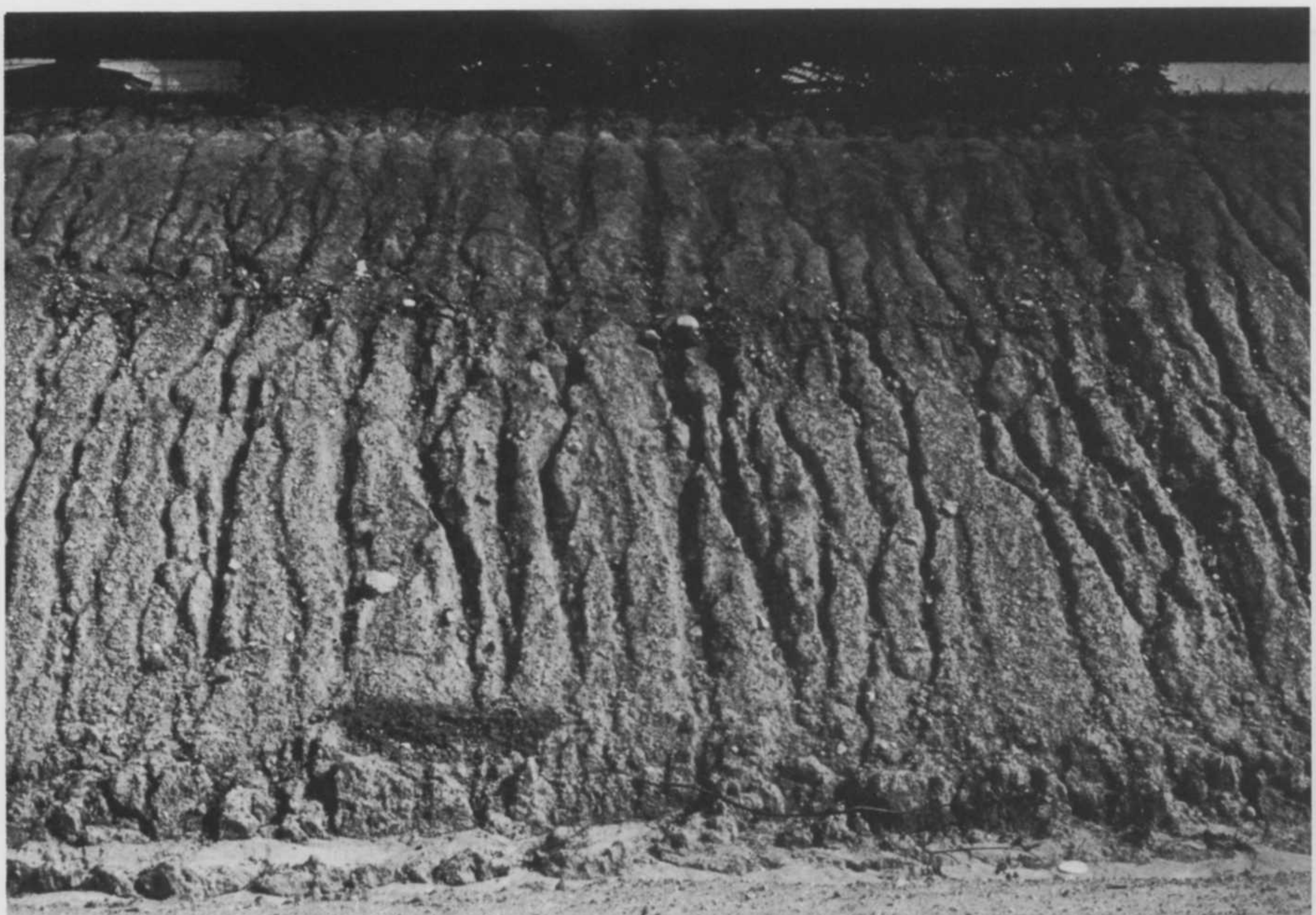


Figure 5: Eroded road cut could have been avoided by proper sodding and soil preparation.

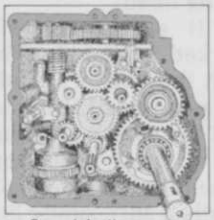
WHAT MAKES A GRAVELY RUN. AND RUN. AND RUN.

Sleek, slick looks notwithstanding, it's the guts of a tractor that make it run. And keep it running.

And no other grounds maintenance tractor has the guts of a Gravely.

THE STORY OF OUR LIFE.

Beneath a Gravely's impressive exterior, lies an even more impressive interior. Designed to give each and every Gravely a long and lively life.



Gravely's all-gear direct drive. A transmission with a lot of teeth in it.

The Gravely 8-speed transmission is a good example. The result of years of testing, it delivers the precise speeds and power you need to do a lot of jobs a lot easier. And a lot better. You get steady power at its lowest ground speed to handle the muscle jobs like snow removal. You also get a choice of seven other speeds for mowing, hauling and other tasks.

HANDLE WITH EASE.

The instant forward and reverse increases its maneuverability, while reducing operator fatigue. Handling is further enhanced by heavy duty, durable rack-and-pinion steering.

THINGS ARE TOUGH ALL OVER.

Every possible part of a Gravely is built extra tough to stand up to year after year of hard, demanding work. The transmission housing is cast iron. As is the pivoting front axle. The rear-mounted engine is bolted directly to the transmission for power train efficiency, improved traction and a low center of gravity.

ALL-GEAR DIRECT DRIVE.

The exclusive Gravely all-gear, direct drive from engine to attachments improves power transmission. And because it is all-gear, it completely eliminates bothersome belts which have always been prone to break, slip or wear out. Also, the precision-cut gears run in an oil bath, for less friction and longer life.

MORE REASONS OUR CUSTOMERS HAVE GROWN ATTACHED TO US.

A Gravely 4-wheel tractor operates 6 different mowing attachments alone. Other attachments are available for plowing, cultivating, tilling and snow removal. A Gravely also powers a seeder, sprayer, thatcher, sweeper, compost shredder, aerator and even a log splitter. Enough to handle just about every kind of grounds maintenance job imaginable.

THE LAST TRACTOR YOU'LL EVER NEED?

How to keep your tractor from going into hibernation for the winter.

In addition to building tractors to last, Gravely wants its attachments to last, too. That's why most Gravely attachments are engineered to be completely compatible.

This protects your investment by making sure that most Gravely attachments will be compatible with both old and new tractors.

Which brings us to yet another reason our customers have grown so attached to us.

With as well as a Gravely performs, you won't want to replace it.

With as well as a Gravely is built, you probably won't have to.

GRAVELY

Clarke-Gravely Corporation
A Studebaker Worthington Company

Authorized GSA Federal Supply Schedule GS-07S-02447.

FOR THE GRAVELY DEALER NEAREST YOU, OR FOR MORE INFORMATION, CALL TOLL-FREE 1-800-528-6050 EXT. 280. OR SIMPLY WRITE TO US AT: GRAVELY, 0124 GRAVELY LANE, CLEMMONS, NORTH CAROLINA 27012.

Superintendent Uses Steel Piling To Solve Muskrat, Erosion Problems

When the grounds crew at Bay Pointe Golf Club in West Bloomfield, Michigan, declared war on an army of muskrats burrowing under the fairways and greens they found they solved erosion and mowing problems, and developed a new type golf cart bridge at the same time.

Don La Fond, superintendent for the 18 hole private course, began last fall driving lightweight steel sheet piling with a self-modified backhoe to completely encircle the course's four ponds.

The ponds had been stagnant and marshy, inhabited by muskrats often burrowing as much as 20 feet into a fairway or green, annually causing significant damage.

"A person could break his leg stepping into a soft spot over a burrow," La Fond said, "And there were plenty of burrows. We had to collapse entire areas, then re-sod. Considering the time and expense, we decided to do something preventative before the place turned into a muskrat ranch."

Opting for the ounce of prevention, Bay Pointe ordered 75 tons of lightweight steel sheet piling from L. B. Foster Co.'s Detroit office. The seven gauge piling was delivered in 4, 10, 12, and 14 foot lengths, uncoated and ready for driving.

To put down the sheets, La Fond used a highly mobile pile driver he had devised from backhoe and a flatbed truck. He bolted a heavy steel plate to the backhoe's bucket to serve as a durable battering head.

"It sounded feasible, so we did it and it worked," he said. "First we'd break the frost line with the bucket's teeth, then drive the piling with the plate until it hit solid ground.

"We used a combination of lengths, some as little as four feet, some as much as fourteen, depending on the condition of the soil. It was mostly a stiff, sandy loam, but we did hit pockets of quicksand where we had to use the longer lengths."

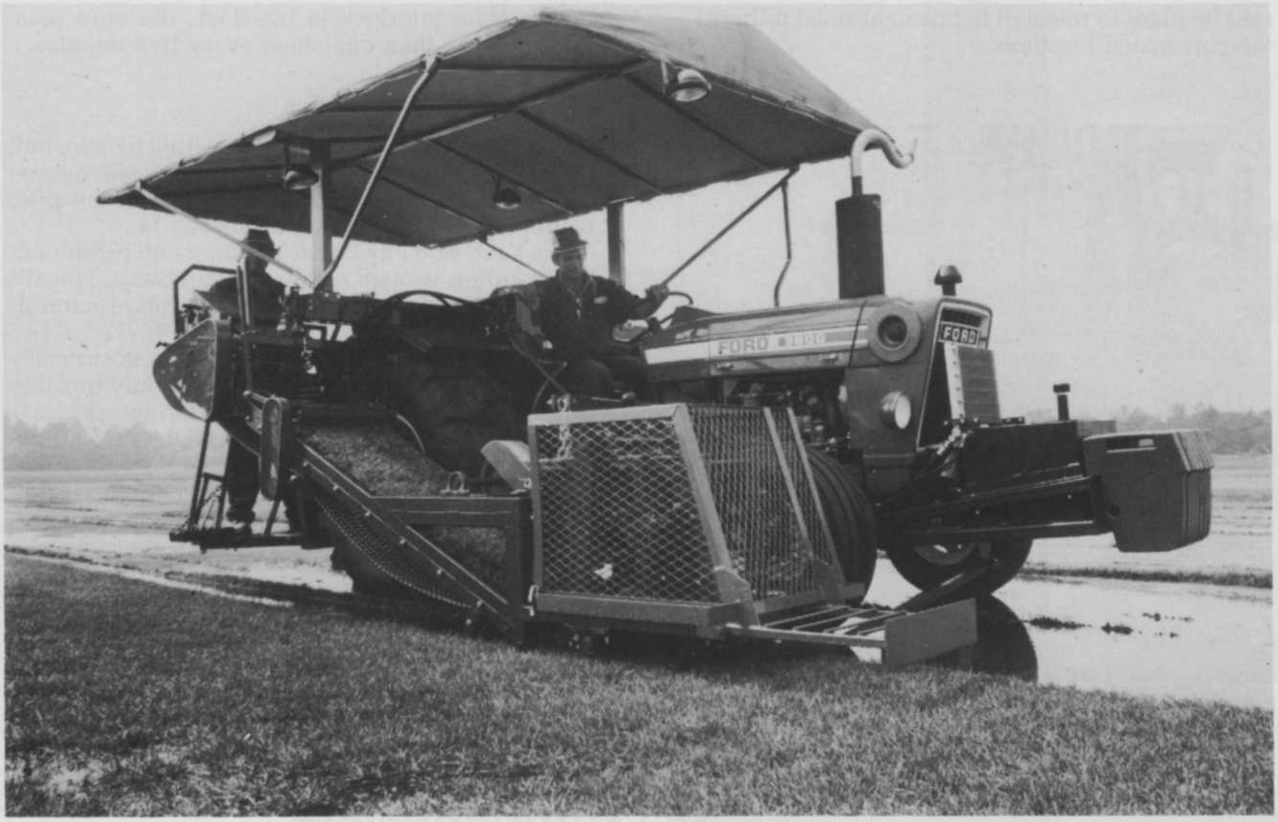
La Fond said the sheets were driven to an even head level in most cases, and required very little trimming in spite of the force of driving on the heads. Lightweight piling can also be driven with a jackhammer, drop hammer or any of several light pile drivers.

La Fond noted that seven gauge steel sheets are one of the few types of lightweight piling that will drive easily through soil containing buried tree stumps, roots or rocks.

"Corrugated metal bends and wood splits," La Fond said. He had installed a corrugated erosion

Corrugated sheets (lower left) show more wear even though they were installed after the piling (center).

BROUWER The World's Most Advanced and Economical Sod Harvester

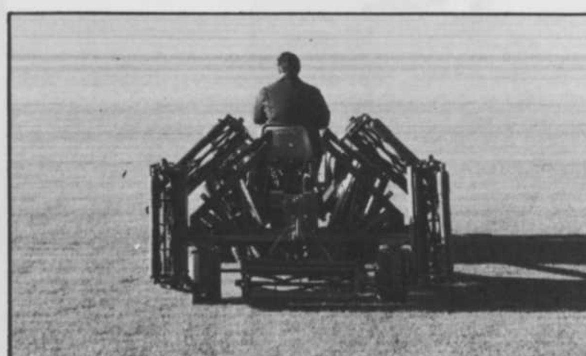


Model A3A

- Operates in all conditions — wet, soft, dry, hard
- Rolls, Slabs and Folds
- Cuts 15", 16", 18" and 24" widths
- Cuts up to 13,500 sq. ft. per hour

THE NEW 7 GANG P.T.O. DRIVEN REEL MOWER

Mowing width 16 ft.



Transport width 8 ft.

IDEAL FOR ALL AROUND TURF MAINTENANCE

BROUWER
TURF EQUIPMENT LTD.

R.R. No. 1, Keswick, Ontario L4P 3C8
Telephone (416) 476-4311

barrier along the course's Middle Straits Lake shore, but after backfilling, the weight of the soil began to bend the corrugated outward. La Fond said he plans to reinstall lightweight sheet piling at the corrugated locations.

Bay Pointe superintendent Don La Fond Explains use of heavy steel plate on backhoe bucket to drive piling around ponds.

Using the backhoe driver system, La Fond's three man crew was able to install 120 feet of piling to grade in about six hours. As the sheets are 17.73 inches from interlock to interlock, the crew was driving more than one sheet every five minutes.

Setting The Sheets By Eye

La Fond did most of the pile setting by eye, but in places where a perfectly straight line was necessary, at a pumping station for example, the pile would be guided in along a railroad tie.

La Fond said Bay Pointe's Owner and President, Ernie Fuller, wanted as few straight lines as possible along the ponds, to make them more natural looking.

"Lightweight sheets are well suited to curves," according to La Fond. "We found we could flex the piles 16° relative to each other at the interlocks."

When the driving job is finished, steel piling caps will be installed along the top rims, and the area behind the pilings backfilled to ground level. The result, La Fond said, will be smooth, muskrat-proof shorelines, safe from erosion and easy to mow along.

From Muskrats To Bridges

An innovative man, La Fond didn't stop with protected ponds. To keep them from stagnating, he devised a plan to pump water from the lowest,

HUSTLER WorkMates™

There's a difference: they just plain out-hustle all the rest.

Our new HUSTLER WorkMates are better than any HUSTLER you've ever seen, or we've ever built.

They'll out-hustle any out-front mower any time, any place. Dual hydrostatics direct to drive wheels let them perform maneuvers you wouldn't think possible from a 72" or 54" mower.

What's more, using HUSTLER WorkMated attachments, they'll do it all year long. On grass, snow, walks or drives.

HUSTLER 275 or 285. Best tractor we've ever built! Improved from engine to deck with new safety features and modifications. Together with proven HUSTLER hydraulic power steering, they operate easier, for superior results.

Crews are crazy about HUSTLER's broken-field running...the way it maneuvers around trees and bushes that slow down ordinary mowers. The biggest problem supers have with their crews is settling the arguments over who gets to operate the HUSTLER, when there's a choice of machines!

Watch for a field demo, or write for literature and Distributor's name. Or call toll-free (800) 835-3260. In Kansas or Canada, call collect (316) 327-4911. For GSA contract, GS-07S-02441; for HUD, OAH(CO)m 2297. HUSTLER turf and groundskeeping equipment by Excel Industries, Inc., Box 727, Hesston, KS 67062.

HUSTLER
Turf Equipment
There's a difference!

EXCEL INDUSTRIES, INC. / Box 727 / Hesston, Kansas 67062 / (316) 327-4911 / (800) 835-3260

Circle 124 on free information card

largest pond to the highest, and then on by gravity to the other two. The gravity flow was guided by a five foot wide stream bed cutting through several fairways. It was well planned and added a new feature to the course, but it necessitated construction of two new cart bridges.

"A good wooden cart bridge with railings will cost about $900 and have to be replanked each year as golf cleats wear out the walking surface," La Fond said. "Also the railings create an unnatural, unwanted obstruction on the course."

Looking again to lightweight steel sheet piling, La Fond found that four sheets, interlocked and laid across the stream, had the qualities of a reasonably sturdy cart bridge. He then discovered that the three lengthwise channels created by the piling's shape were a perfect fit for the three wheel track of the course's golf cart fleet. The three inch deep channels eliminated the need for the obtrusive railing.

"You can actually drive the carts across the bridges with your hands off the wheel," La Fond said.

To accommodate walkers, a 1½ inch layer of cart path slag was applied to the channel bottoms, preventing metal to metal contact between cleats and bridge.

Cost of the two sheet piling bridges came to about $250, or $650 less than the cost of one good wooden span, he said.

La Fond also used lightweight piling to construct the pumping station screen gate frame. He welded two sheets back to back, and added L-shaped steel caps along their lengths to form tracks guiding a sliding screen to keep debris out of the pump. The screen slides out of the water for cleaning.

Golf cart tires fit the grooves created by four sheets of piling. Gravel placed in grooves allows golfers to avoid the grinding of cleats on the metal sheeting.

Right now, La Fond is considering lining the course's stream banks with lightweight steel piling to help prevent erosion and facilitate mowing. **WTT**