From:	Aldo Tarigo
To:	Taylor, Tammy
Subject:	21 Barranca documents
Date:	Tuesday, September 04, 2018 3:46:50 PM
Attachments:	180903 Discrepancies between 21 Barranca Rd Project Documents and Initial Study Interpretation.pdf

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Hi Tammy,
I will be dropping off 2 sets of hard copies of the documents sent last week, today after hours, and includes the attached narrative.
Aldo

September 3, 2018

Discrepancies between 21 Barranca Rd Project Documents and Initial Study Interpretation

- Lot Coverage, both existing and proposed, are miscalculated in the Initial Study, indicating an increase in Total Impervious Area of 84% for the proposed project. It actually proposes a net decrease of TIA by 28%. This error originated due to the following incorrect data:
  - The proposal specifies TuffTrack, a pervious paving system, for the new driveway, but it is treated as impervious in the analysis, while a product with inferior specifications for permeability is recommended as a mitigation. Proposed Lot Coverage is mistakenly inflated some 2000sf by the inclusion of this pervious area.
  - From the outset the project has proposed the restoration of 2300sf of semi-pervious compacted road base to ecologically functional habitat, as described in the text of the Initial Study. However, this area is omitted from the total for existing Lot Coverage, and its conversion to permeability is not shown to have lowered TIA as proposed. Marin County Code specifies that any surface with runoff of more than 50% shall be included in Lot Coverage. It is unclear why it was not included after our project was assigned to a second planner due to a change of personnel, and this omission was only revealed to us in the IS. Upon identifying such a dramatic addition to Lot Coverage, Planning should have verified the figure or warned us that if it was correct, the project would be in violation of the County Wide Plan. Furthermore, when we pointed out this error, among others, we were denied any route to correcting the data other than the current appeal.

- Of the above mentioned 2300sf, a surplus of 1700sf remains over and above the portion which would achieve a net zero change in TIA for all construction, consistent with the County Wide Plan. This would represent a mitigation of nearly 15 to 1 to allow for 115sf to be located in the 20' creek drainage setback, very generous compared with the ratios of mitigation discussed for a potential standard to be incorporated into an SCA ordinance. Approximately two-thirds of this area is on existing footprint, while the other one-third is on the aforementioned semi-pervious area, creating no new environmental impact, as is supported by the Biological Report. A large part of the intended function of the 20' drainage setback is more than met by diverting roof runoff to the proposed rain-garden south of the house, a larger and more ecologically beneficial version of a required dispersion trench. Additionally, outside the 2300sf, but within the area of proposed bank restoration, replacement of the compacted gravel driveway between the existing 2nd unit and creek with new soil and native plants will improve soil porosity and thus improve absorption of rainfall directly on this area. Further, the modest 5'9" encroachment into the setback is necessary to create southern exposure to allow passive solar heating, which would contribute an ongoing environmental value in reduced carbon footprint due to enhanced energy performance of the building in perpetuity.

- Marin County Code requires 24" of freeboard above the 100-year high water event. The Initial Study references only the 2014 'Hydrology and Hydraulic Analysis' by CSW/ST2, in response to which DPW asserts that the bridge does not meet this requirement. That assessment is based on the TR-55 method for determining peak flow in ungaged creeks where no local data is available, a standard method. The project parameters in 2014 included the existing extremely narrow creek channel north of the bridge formed by a concrete retaining wall on the east bank and natural rock on the west, as well as imprecise creek bed topography as shown in the 1994 property survey. Modeling showed the 100-yr flow level topping the creek bank at the large fir tree, some 64ft north of the bridge. This last point shows that the modeled flooding was not caused by the bridge but significantly upstream of it, but seems to be the reference on which the inaccurate description in the August 27 Staff Report was based.

- The hydrology report was updated in 2017 to reflect the removal of the retaining wall from the project scope and includes updated site parameters. In addition, it utilizes two more recent modeling methods based on measured data from local and state sources, which result in a more accurate assessment of the bridge's performance, and determine that it has more than the required minimum of 24" freeboard. It too was prepared by CSW/ST2, licensed professionals in good standing, using gaged data to yield more realistic results consistent with local measure, yet DPW classifies these as "unusual" or "non-standard" methods, apparently simply because they are not TR-55, as reason to invalidate the data.

- The Existing Conditions section of the San Geronimo Valley 2009 Salmon Enhancement Plan makes use of 26 years of actual gaged data to project the 100-yr peak flood elevation of San Geronimo creek at Lagunitas Bridge. Since Barranca creek is a tributary of San Geronimo creek, this data was used to extrapolate the 100-year peak water elevation at the bridge at 21 Barranca Rd, which when modeled substantiates a freeboard of 29" from water surface elevation (WSE) to bottom of the span. The other method, the USGS's "Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006", published in 2012, results in an even lower WSE, yielding an even greater freeboard measurement. In comparison, the County-preferred TR-55 method overestimates peak flow by as much as 46% as compared with the published SGV SEP data, thereby reducing apparent freeboard to less than the 24" required by code. Flow transference methods, as used in the SGV SEP and our hydrology report, are preferred by California Department of Forestry and Fire Protection (Cal Fire) for determining 100-year flood flows, providing much more accurate data than regional regression modeling such as TR-55. Cal Fire further recommends that the TR-55 result should be calibrated to local measured data wherever such data exists. Doing so by using the lower end of the 90% confidence level, the bridge does then meet the 24" required minimum freeboard.

- DPW cites policy in the guise of code to require a redesign of the bridge so that its supporting structure is entirely beyond top of bank and above the 100-year flow, even though this wording is not found in the code. Rather, the bridge is consistent with MCC 24.04.520 (a) & MCC 24.04.530, which provide clear direction for the design of such structures within the creek with the stipulation that it can be demonstrated that erosion will not occur, which is the case for the bridge as built. This is supported by analysis of flow velocity in the hydrology report addressing the original bridge alignment and its continuation in the reconstructed bridge, as well as by the absence of evidence of erosion or scour according to the biology report. Further, the suggested bridge replacement specifications would more than double the impervious area of the bridge, interfere with code-required drainage away from the house, and create a problematic turning radius on approach, conditions which may well interfere with other required code. It is also remarkable that the environmental impact of removing the approximately 43 ton concrete and steel existing bridge is nowhere considered in the current evaluation, since the bridge is considered non-existent for the purposes of the retroactive permitting process. The fact that it was brought into existence illegally in an emergency should not preclude an impartial assessment, the absence of which would then require an astonishingly unnecessary adverse environmental impact to build a bridge which performs more poorly both environmentally and practically.

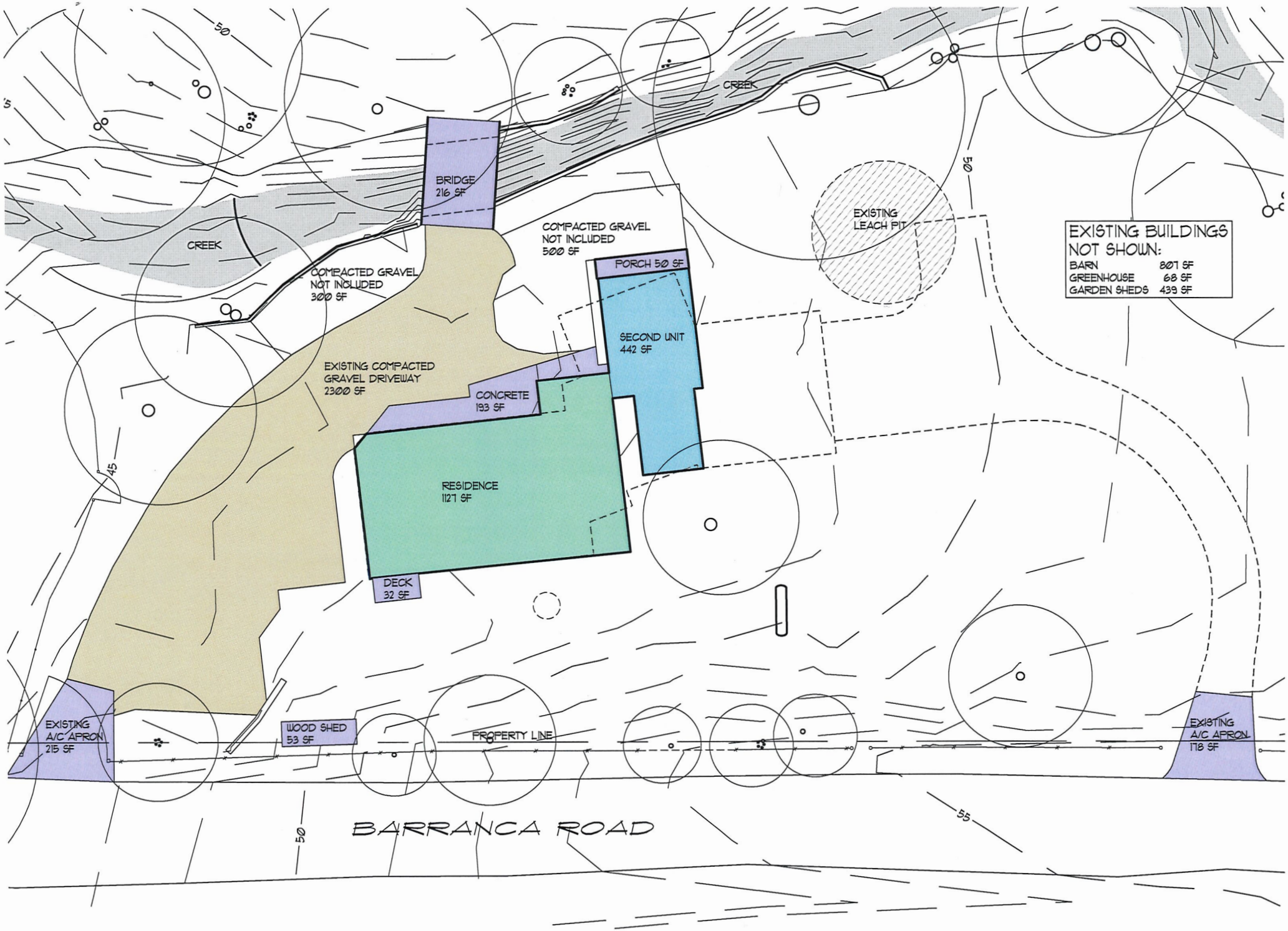
- To address matters not covered in the IS, but alleged in the August 27 Staff Report, we provide the following: Without foreseeing the utter regulatory disaster it would create for us personally, we replaced our bridge without permits in late 2006 on the forceful urging of the biologist then with SPAWN (likely acting unofficially), who strongly made a case for its emergency replacement to eliminate the threat its possible catastrophic failure posed to endangered coho salmon. The bridge had recently partially collapsed and was continuing to fail; we had prepared a design for its replacement prior to the warning, however with no pressing sense of urgency, we hadn't yet begun the permit process. After a major structural support log fell into the creek, and with the impending onset of the rainy season along with the foregoing plea, we were prevailed upon not to delay by applying for a permit and were persuaded to proceed as the environmentally responsible thing to do. Unfortunately, we did not know of the process of retroactively permitting work done on an emergency basis then, nor were we so informed when its un-permitted status came under suspicion by DPW in 2008. The description of being warned to cease during its construction is <u>entirely false</u>: it was structurally completed in November 2006, 2 years before a DPW site visit on another matter when it aroused Dave Nicholson's suspicion, and 5 years before we applied for permit with our current proposal in late 2011. Of significant note, peak flow in water year 2006-7 measured at the Lagunitas bridge gage, as published in the 2009 SGV SEP, recorded a high water event that year within 10% discharge of a 100-year event, which supports the biologist's assertion of risk of environmental harm from further failure of the bridge. At a minimum, even without complete collapse, a large quantity of fine organic debris would have washed into the creek; the effect of silt in the water on fish is similar to that of smoke inhalation for humans, and thus clearly a detrimental impact. During construction, 10-12 cubic yards of such material was carried off and composted (it now grows raspberries), with any that fell caught in a tarp and removed without entering the creek. The water remained clear throughout construction, which we can document with photographs, which also comprehensively document the engineering, craftsmanship and structural integrity of the bridge. Upon request we will provide structural drawings as well, in advance of their anticipated normal submission as part of the building permit application.

Tarigo/Terrass Project Areas

August 31, 2018

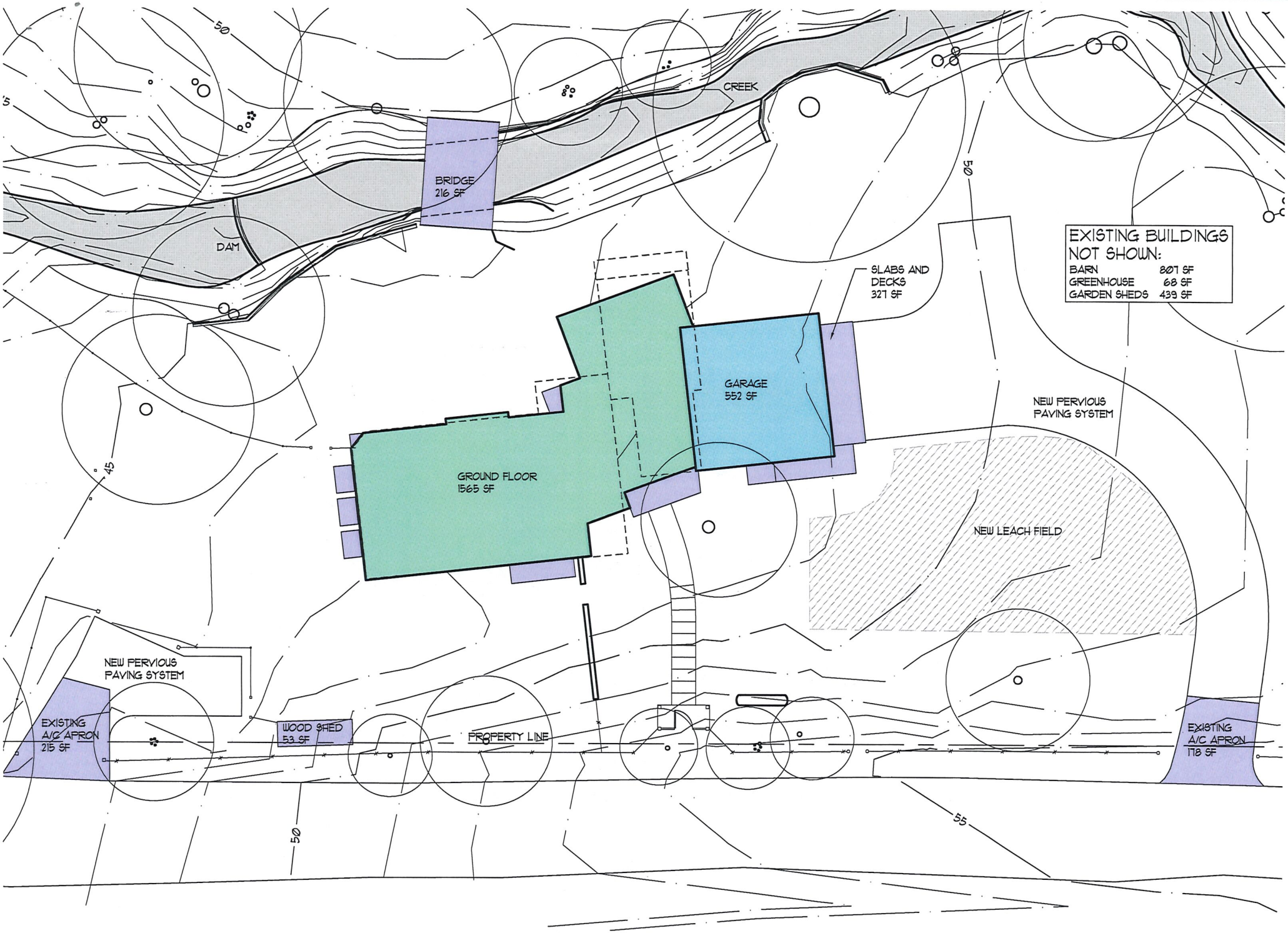
	Floor Area (F.A.R.)		Building Area (actual)		Interior Area (for Septic)		Impervious Area (Lot Coverage)	
	Existing	New	Existing	New	Existing	New	Existing	New
First Floor	1127 sf	1565 sf	1127 sf	1565 sf	1042 sf	1416 sf	1127 sf	1565 sf
Second Floor	1129 sf	1090 sf	1129 sf	1090 sf	1042 sf	942 sf		
Third Floor Loft		137 sf		137 sf	-	106 sf		
Total House	2256 sf	2792 sf	2256 sf	2792 sf	2084 sf	2464 sf		
2nd Unit	442 sf	552 sf	442 sf	552 sf	401 sf	505 sf	442 sf	
Total Conditioned	2698 sf	3344 sf	2698 sf	3344 sf	2485 sf	2969 sf		
Garage	-	12 sf	-	552 sf			-	552 sf
Slabs and Decks	-	-	-	-			275 sf	327 sf
Bridge	-	-	-	-			216 sf	216 sf
Driveways	-	-	-	-			2693 sf	393 sf
Accessories Bldgs.	917 sf	917 sf	1367 sf	1367 sf			1367 sf	1367 sf
Sub Total	917 sf	929 sf	1367 sf	1919 sf				
Grand Total	3615 sf	4273 sf	4065 sf	5263 sf	2485 sf	2969 sf	6120 sf	4420 sf
F.A.R.	5.33%	6.30%						

Area of existing semi-pervious road base with a water runoff factor > 0.5 (included in Driveways above)	2300 sf
Area of additional existing semi-pervious road base	800 sf
Area of new Tufftrack pervious paving system	1949 sf



21 BARRANCA RD - EXISTING SITE IMPERVIOUS

AUGUST 31, 2018



21 BARRANCA RD - PROPOSED SITE IMPERVIOUS

AUGUST 31, 2018

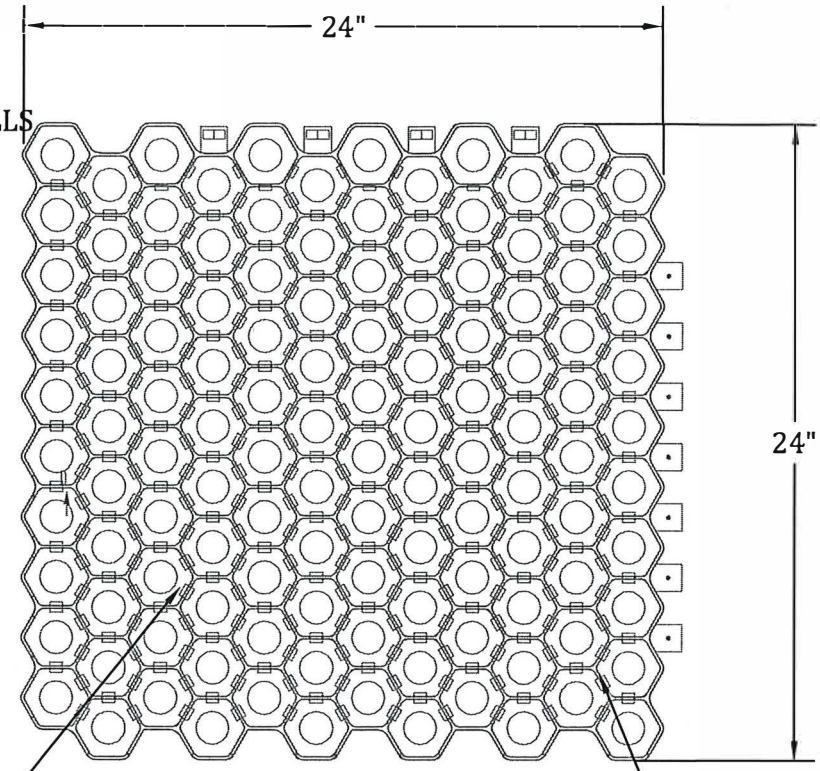
TUFFTRACK PRODUCT DESCRIPTION

PANEL SIZE - 24" x 24" x 1 1/2"

CELLS PER PANEL - (120) - 2-1/2" HEXAGONAL CELLS

NESTED HONEYCOMB CELL LAYOUT

COMPRESSIVE STRENGTH - 98,770 PSF
685 PSI
EXCEEDS H20
LOADING



NOTE:
SOIL SEPARATOR MAY BE REQUIRED ABOVE STONE BASE MATERIAL IF USING AGGREGATE WITH A HIGH VOID RATIO

TONGUE & GROOVE LATCHING SYSTEM

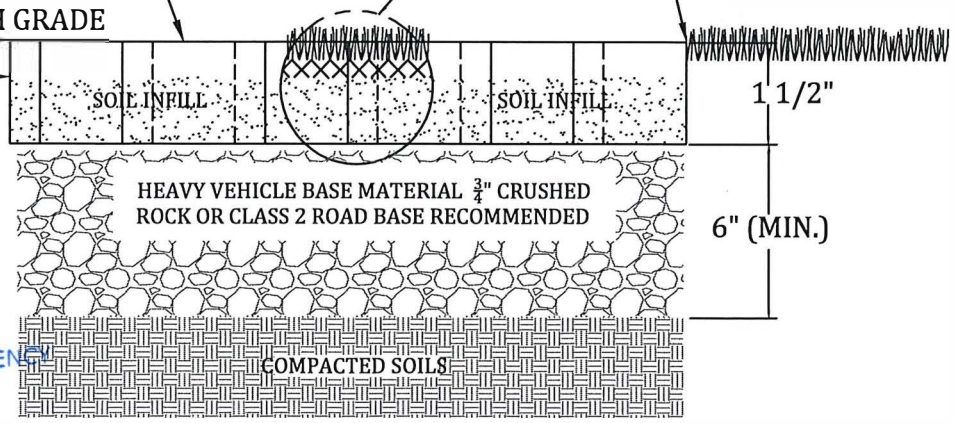
"SOD" PLANTING LEVELS INSIDE CELLS

TUFFTRACK GRASS ROAD PAVER

ADJOINING FINISH GRADE

PAVER GRIDWORK FINISH GRADE

TOP OF SOD AFTER SETTLING INTO CELLS



NOTE:

EXISTING SOILS SHOULD BE EVALUATED TO ENSURE PROPER STRUCTURAL AND PERMEABILITY PROPERTIES.

NDS

TECHNICAL SERVICES
1-888-825-4716
techservice@ndspro.com

TYPICAL TUFFTRACK PAVER DETAIL

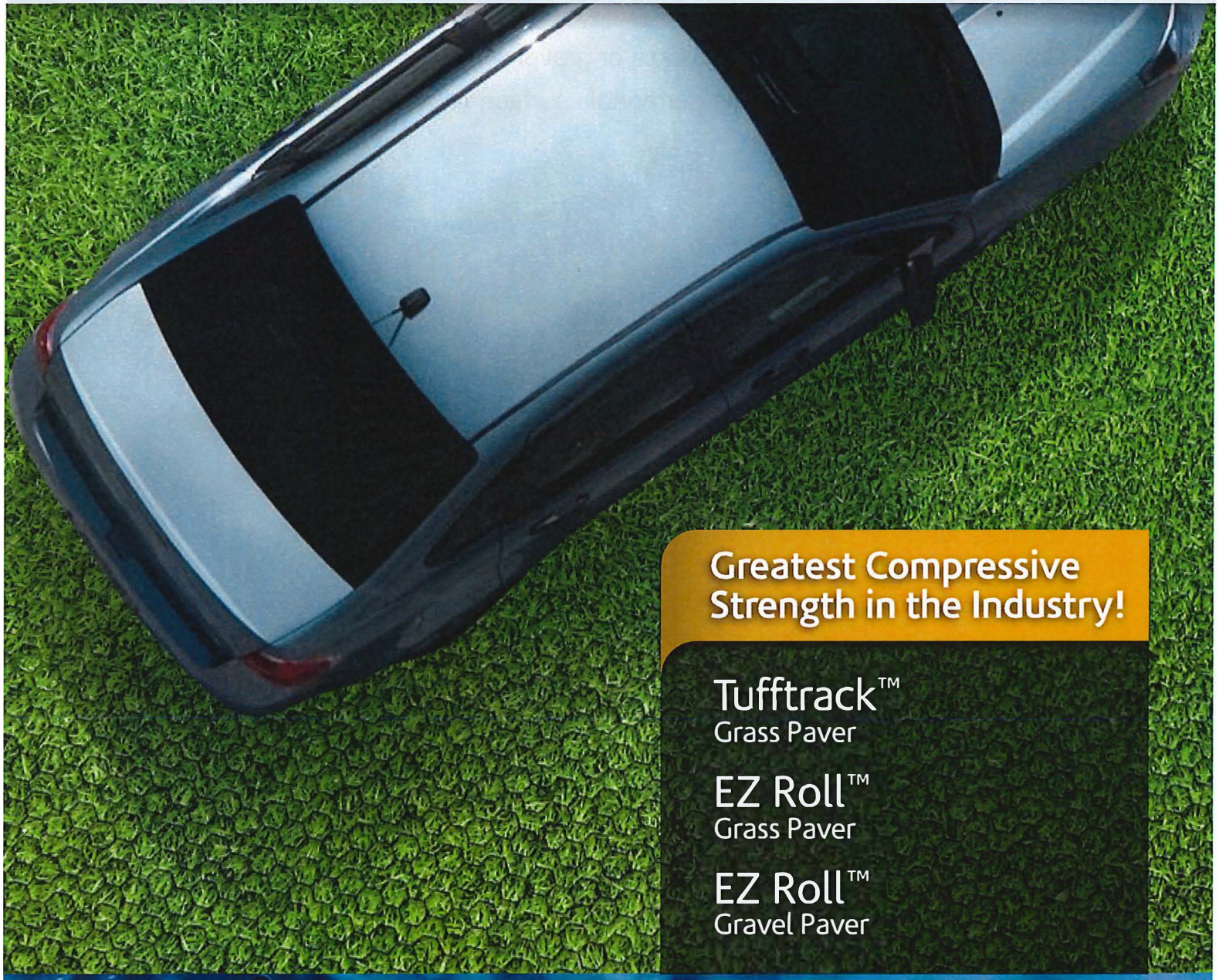
MEDIUM LOAD TRAFFIC AREA

N. T. S.

NDS®
We put water in its place

Permeable Pavers

High performance alternative to traditional paving



Greatest Compressive Strength in the Industry!

Tufftrack™
Grass Paver

EZ Roll™
Grass Paver

EZ Roll™
Gravel Paver

ndspro.com

MADE IN USA

What are Permeable Pavers?

NDS Permeable Pavers provide a high-performing alternative to traditional paving methods.

Creating a strong and durable grass or gravel surface that can support heavy vehicles, they maintain permeable surface areas, eliminating or reducing stormwater runoff.

Benefits

Stormwater Management. A sustainable solution that reduces impervious area, volume of runoff, and size of downstream BMPs.

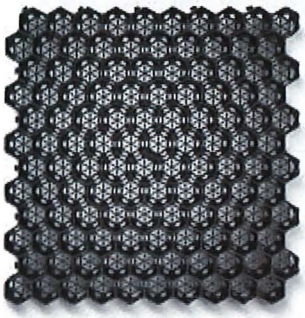
High Structural Strength. Offering a high load bearing capacity, NDS Permeable Pavers feature hexagonal cells that connect to form a flexible grid capable of handling significant structural loads.

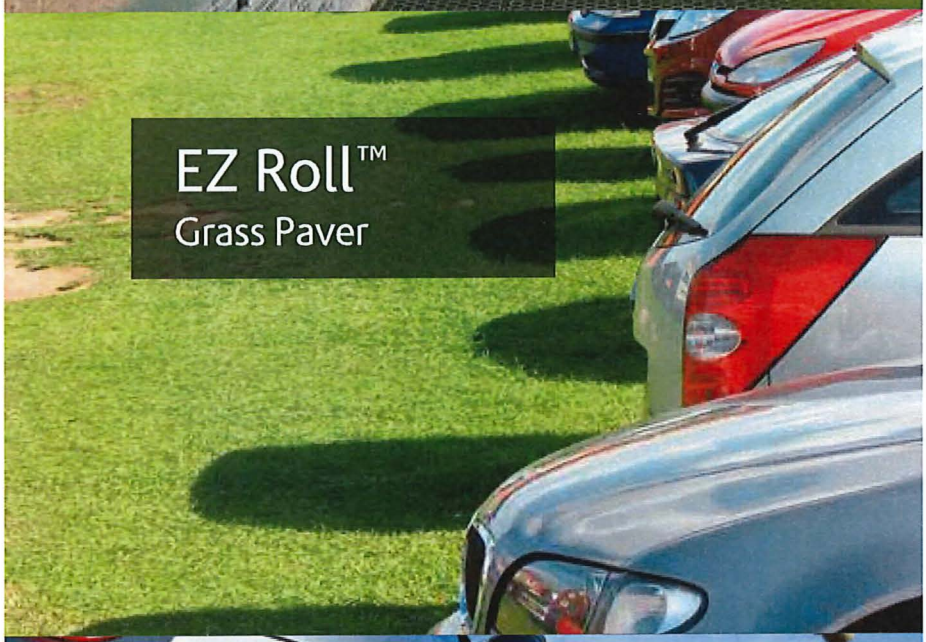
Enhanced Aesthetics. Grass or gravel surfaces blend with surrounding natural surface.

Easy Installation. EZ Roll™ Products come in large rolls that are easily placed and clipped together. Tufftrack™ features an integrated easy assemble clip that greatly reduces installation time.

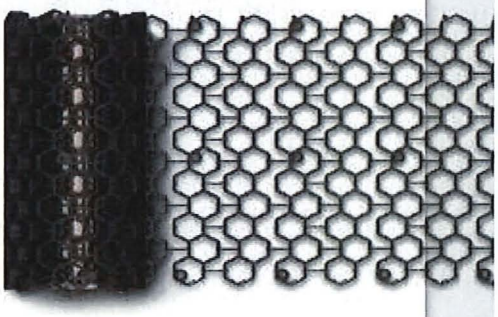
Environmentally Friendly. NDS permeable pavers can help contribute to LEED credits and are made of recycled plastic.

Tufftrack™
Grass Paver

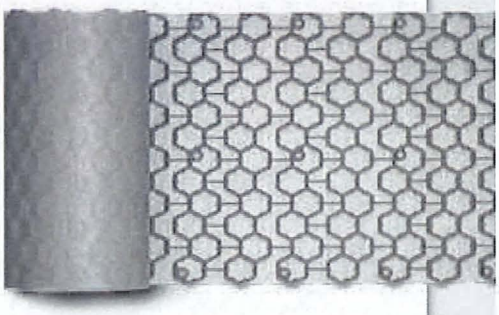




EZ Roll™
Grass Paver



EZ Roll™
Gravel Paver

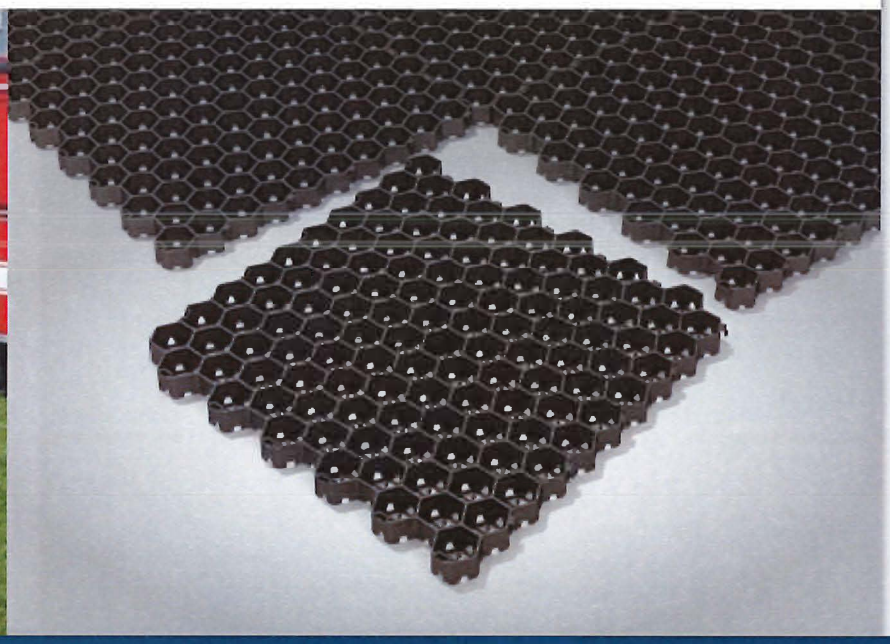


Tufftrack™ Grass Pavers

A turf reinforcement, load transferring paving system designed to be placed directly on a lightly compacted planting base which is installed over an engineer specified compacted road base.

It can also be used for light load applications without road base by simply compacting the planting base per engineer specification. This system is designed to transfer vehicle weight directly to the supportive base course and prevent soil compaction. The web of interconnected honeycomb cells provides resistance from vehicular load as well as lateral containment that prevents the soil compaction that would inhibit healthy root growth. This system also provides a porous condition that allows rapid absorption and movement of stormwater. Tufftrack Grass Pavers can be infilled with soil per specification. Tufftrack Pavers have a compressive strength of 86,563 lbs. in an empty condition; 400,000 lbs. when filled with native top soil. The Tufftrack Grass Paver system has been used and accepted across the country for a wide variety of projects including emergency vehicle access purposes.

Additional information, details, and specifications can be found at
http://www.ndspro.com/permeable-pavers/grass-pavers/tufftrack-grass-pavers
For further technical support or assistance, contact: techservice@ndspro.com

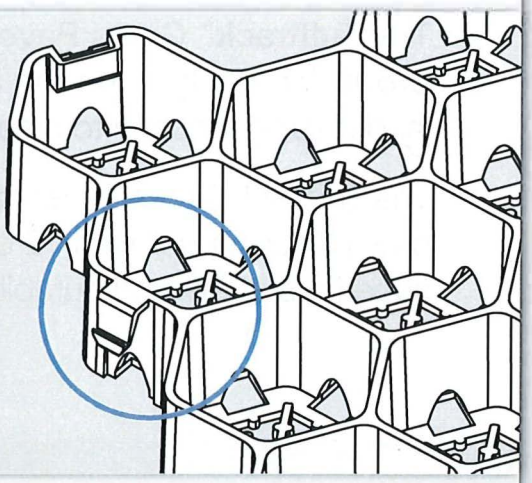


Design Theory

Tufftrack™ Grass Paver has unique Tongue and Groove clips that minimize the paver mat separation and make for quick installation

The Tufftrack™ Grass Paver's secure locking clips prevent paver displacement or mat failure that could result from traffic load movement or changing ground conditions

The Tufftrack™ system has a high compressive strength bare product, meaning that Tufftrack does not rely on the fill material for load carrying



Recommended Use

Light Loads:
Golf Cart Paths
Jogging Tracks
Bike Paths
ATV Paths
Equestrian Parks
Trail Reinforcements
Runoff Areas

Medium Loads:
Roadway Shoulders
Residential Driveways
Parking Lots
Overflow Parking Area
Truck & Cart Wash-Down Areas
RV and Boat Access

Heavy Loads/Fire Lane:
Fire Lanes
Emergency Vehicle Access Roads
Service Vehicle Utility Roads
Truck Maintenance and Equipment Yards
Construction Entrance Soil Stabilization
Consult NDS Design Worx during design phase when the intended use is semi trucks with trailers

Non-load Applications:
Erosion Control on Slopes (staking recommended)
Erosion Control in Swales (staking recommended)

Not Recommended for the Following:
Traffic on slopes exceeding a 10% grade
To support tread driven vehicles

The Tufftrack™ Grass Paver from NDS is the latest and most advanced product of its type on the market. NDS has used its years of experience in the landscaping industry to create a product with all of the most desirable features.

The Tufftrack Grass Paver has a combined series of 120 nested hexagonal cells per paver cell with 12 connecting clips. This unique combination provides superior stability and durability.

Product Specifications

Material. 100% recycled Polyolefin plastic (50% pre-consumer 50% post-consumer). Polyolefin is rugged, flexible and ideally suited for outside exposure and longevity. NDS uses UV inhibitors in the polymer structure to prevent breakdown in the strength of the paver.

Manufacturing. Manufactured in the USA: Lindsay, CA.

Recyclability. 100% recyclable.
Please recycle whenever possible.

Paver Size. Each 24" x 24" x 1½" panel contains 120, 2½" nested hexagonal cells. Each cell has 6 arched cutouts at its base.

Weight Per Unit. 4.0 pounds per 24" x 24" section.

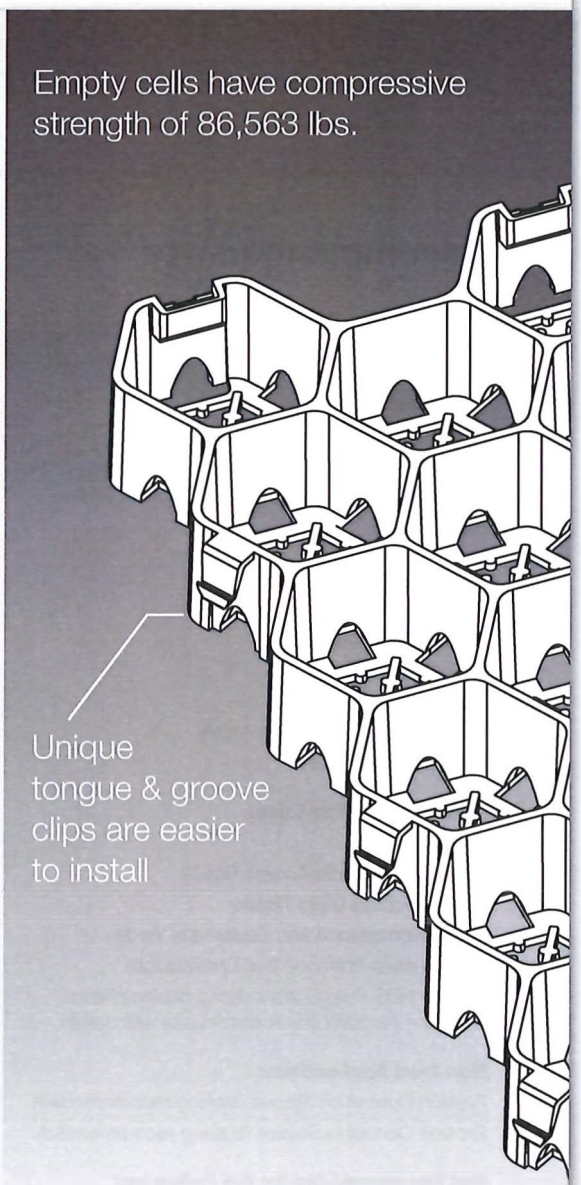
Paver Details. The top surface of the hexagonal cell walls is smooth and devoid of notches or grooves.

Assembly Mechanism. Each Paver section includes 10 sturdy Tongue and Groove locks per panel, which provide secure connection between panels.

Chemical Resistance. Tufftrack™ Pavers have superior chemical resistance and are totally inert.

Compressive Strength (Empty Pavers): 86,563 lbs.
Compressive Strength (Native Soil filled Pavers): 400,000 lbs.

Unique Product Features. Tufftrack™ Pavers have features found in no other grass paver product in the industry. Tufftrack features a unique domed opening at the base of each hexagonal cell wall. This promotes a greater flow of water, oxygen and nutrients. Additionally, the slot opening allows root penetration to the soil below the paver and allows roots to grow between cells, promoting healthier grass. In areas where drainage is critical, Tufftrack increases water runoff capabilities. The Tongue and Groove latching system is another unique feature which provides exceptional stability, longevity, and ease of assembly.



Dare to Compare

Tufftrack™ Grass Pavers are **25% STRONGER** than the competition

Compare the strength of NDS Permeable Pavers to the competition below.

Panel Pavers	Max Load Unfilled (lbs.)	Area (sq. in.)	Max Load (PSI)
NDS Tufftrack™ TT24	86,563	144	601
TrueGrid Pro Plus™	64,361	144	447
TrueGrid Eco™	53,797	144	374
Presto GEOPAVE®	35,682	144	248
Presto GEOBLOCK® 5150	35,220	144	245
AirPave Grass Paver	23,910	144	166

NDS Max load filled cells: 400,000 lbs. (soil)

Pro Plus™ and Eco™ are trademarks of TrueGrid® Pavers. Presto GEOBLOCK® and GEOPAVE® are registered trademarks of Reynolds Presto Products, Inc.

Case Studies – Tufftrack™ Grass Pavers

Union High School

Tulsa, OK

Emergency vehicle lane

When the Tulsa Independent School District prepared to open a new school, the design team needed to incorporate emergency vehicle access roads leading up to the building and athletic facilities. The Tufftrack® Grass Paver was selected for its high compressive strength of 81,744 psf and the flexibility either to sod or seed the area immediately following the 8,000 square foot installation.

Hilton Garden Inn

Elk Grove, CA

Emergency access lane

An emergency access lane needed to be added along the side of the property, but due to the large width of the lane and proximity to the hotel, the owners wanted a solution that would be aesthetically pleasing as well as functional. Tufftrack® Grass Pavers were selected and installed. Twelve years later the site was revisited and inspected. The Tufftrack® base is virtually indistinguishable from the rest of the landscape. The result was, and still is, a highly functional fire lane that can be enjoyed by their guests when not in use.

Installation As Easy As 1-2-3

1

Lay it out

Lay panels out in square or offset pattern over prepared base to cover entire area

2

Clip it together

Tongue-and-groove latching system connects easily without special tools to create an integral paver mat

3

Add soil infill

Fill the cells with soil and top with sod or seed

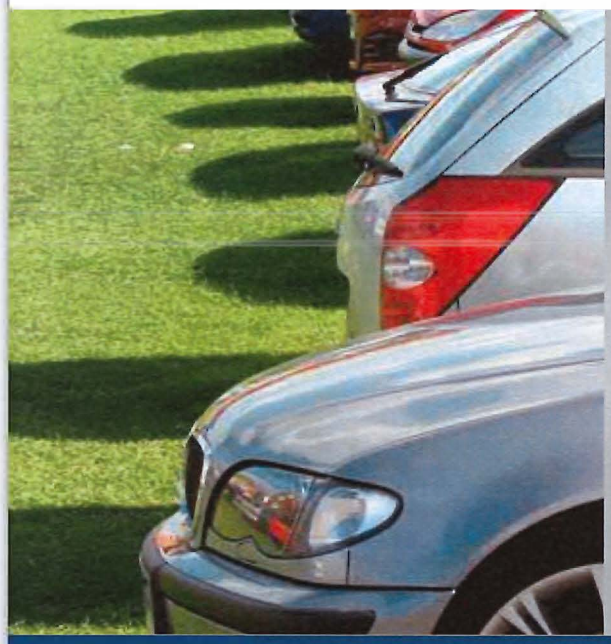
For details & installation instructions visit **ndspro.com/specifications**

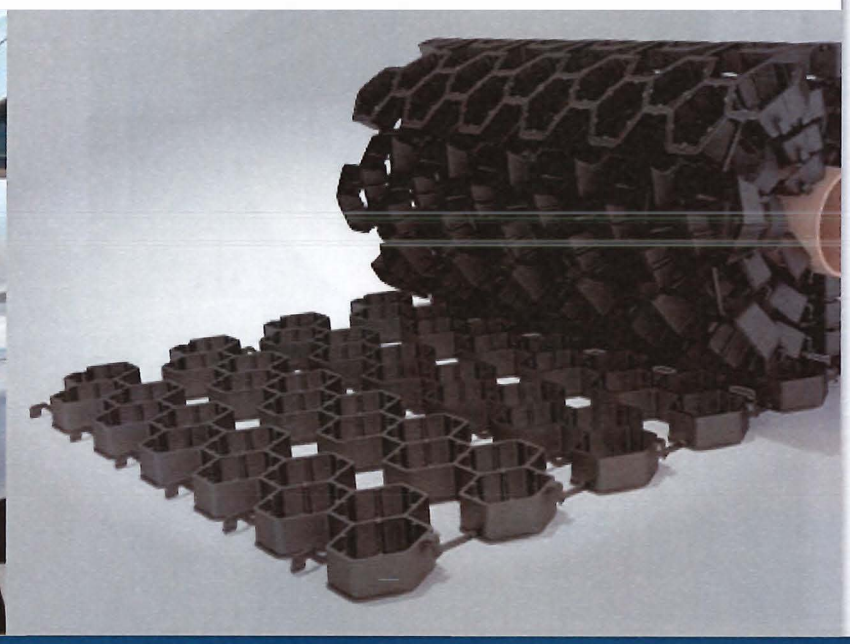
EZ Roll™ Grass Pavers

A turf reinforcement, load transferring paving system designed to be placed directly on an engineer specified compacted road base.

This system is designed to transfer vehicle weight directly to the supportive base course and prevent soil compaction. The web of interconnected honeycomb cells provides resistance from vehicular load as well as lateral containment that prevents the soil compaction that would inhibit healthy root growth. This system also provides a porous condition that allows rapid absorption of stormwater. EZ Roll™ Grass Pavers have a compressive strength of 53,683 lbs. in an empty condition and greater than 400,000 lbs. when filled with native top soil. The EZ Roll™ Grass Paver system has been used and accepted across the country for a wide variety of projects including emergency vehicle access purposes.

Additional information, details, and specifications can be found at
http://www.ndspro.com/permeable-pavers/grass-pavers/ez-roll-grass-pavers
For further technical support or assistance, contact: techservice@ndspro.com



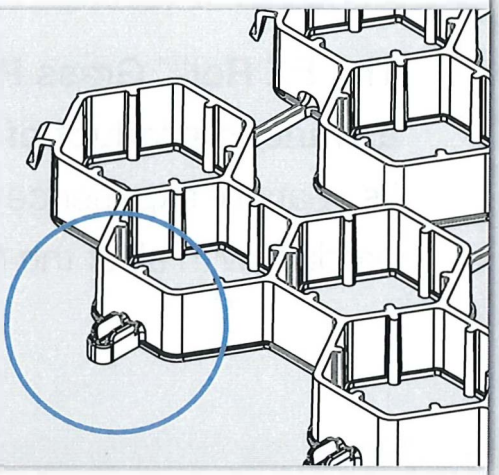


Design Theory

The EZ Roll™ Grass Paver comes in pre-assembled rolls, which means it is easy to roll out, decreasing installation time and increasing efficiency.

EZ Roll™ Grass Paver has been tested for compressive strength at 53,683 lbs. bare product, meaning that EZ Roll™ does not rely on the fill material for load carrying.

Connections between rows of EZ Roll™ are secure due to unique side-to-side and end-to-end clips that minimize the paver mat movement and separation due to lateral and horizontal pressure. These sturdy locking clips prevent paver displacement or mat failure that could result from traffic load movement or changing ground conditions.



Recommended Use

Light Loads:
Golf Cart Paths
Jogging Tracks
Bike Paths
ATV Paths
Equestrian Parks
Trail Reinforcements
Runoff Areas

Medium Loads (occassional traffic):
Roadway Shoulders
Overflow Parking Area
Truck & Cart Wash-Down Areas
RV and Boat Access

Heavy Loads/Fire Lane (occassional traffic):
Emergency Vehicle Access Roads
Service Vehicle Utility Roads

Non-load Applications:
Erosion Control on Slopes (staking recommended)
Erosion Control in Swales (staking recommended)
Semi-Trucks with Trailers

Not Recommended for the Following:
Traffic on slopes exceeding a 10% grade
To support tread driven vehicles
Frequent use traffic, since grass will not have time to recover

The EZ Roll™ Grass Pavers from NDS is the latest and most advanced product of its type on the market. NDS has used its years of experience in the landscaping industry to create a product with all of the most desirable features.

Product Specifications

Material. 100% recycled HDPE plastic (50% pre-consumer 50% post-consumer). HDPE is rugged, flexible and ideally suited for outside exposure and longevity. NDS uses UV inhibitors in the polymer structure to prevent breakdown in the strength of the paver.

Manufacturing. Manufactured in Lindsay, CA.

Recyclability. 100% recyclable. Please recycle whenever possible.

Paver Size. Each 24" x 24" panel contains 72, 2¼" nested hexagonal cells. Panels are integrated with crosslinks and clips to form rolls. Part No. EZ4X24 has dimensions of 4' x 24' per roll and EZ4X150 has dimensions of 4' x 150'. Custom size rolls available upon request.

Paver Details. The top surface of the hexagonal cell walls is smooth and devoid of notches or grooves. The bottom surface of the paver mat has over 80% open area for increased permeability.

Chemical Resistance. EZ Roll™ Pavers have superior chemical resistance and are totally inert.

Compressive Strength (Empty Cells). 53,683 lbs.
Compressive Strength (Native Soil filled Pavers): 400,000 lbs.

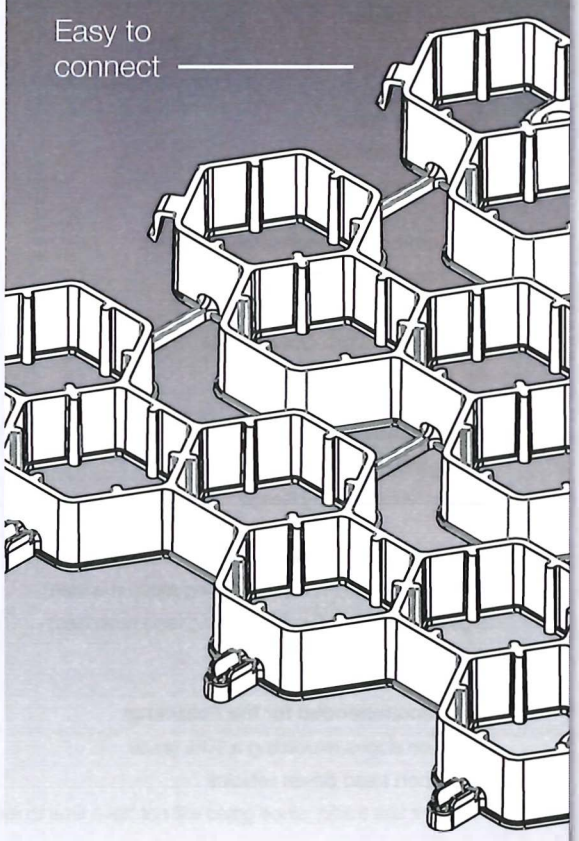
Unique Product Features. EZ Roll™ Pavers feature an easy to install top down locking feature. This locking mechanism allows pavers to be installed quickly and easily.

Empty cells have a compressive strength of

53,683 lbs.

Product ships in large rolls for easy rollout

Easy to connect



Dare to Compare

EZ Roll™ Grass Pavers are **25% STRONGER** than the competition

Compare the strength of NDS Permeable Pavers to the competition below.

Roll Pavers	Max Load Unfilled (lbs.)	Area (sq. in.)	Max Load (PSI)
NDS EZ Roll™	53,683	144	373
ISI GrassPave²	40,623	144	282

NDS Max load for soil-filled cells is 400,000 lbs.

ISI GrassPave² is a registered trademark of Invisible Structures Inc.

Case Studies – EZ Roll™ Grass Pavers

Trump Taj Mahal Casino Resort

Atlantic City, NJ

Fire lane and maintenance access

Access to the building facade was needed for maintenance and to allow access for emergency vehicles. EZ Roll™ was chosen for its strength and flexibility, but also for its aesthetic advantages. The ability to sod directly on top of the product reduced the time needed to seed and wait for growth, while keeping up appearances at the busy casino.

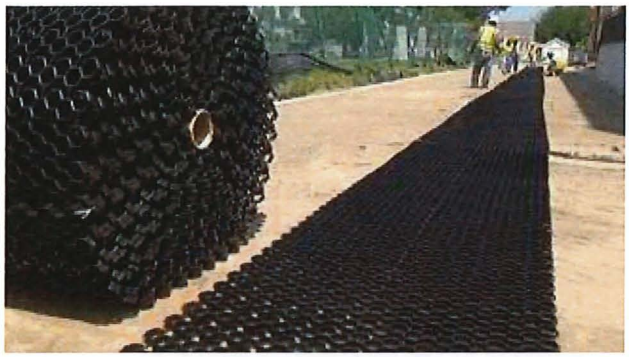
Keller High School

White Settlement, TX

Overflow parking

A new school needed additional parking for their football program and looked to covert a former cow pasture they owned across the street. The solution had to be aesthetically pleasing, cost-effective and demonstrate to the community an ongoing commitment to supporting the environment. The 150,000 sq. ft. project was installed in just 10 days.

Installation As Easy As 1-2-3



1

Roll it out

Manufactured in pre-assembled rolls for fast and easy installation over prepared base

2

Clip it together

Lateral snap-lock system allows rolls to be connected without any special tools

3

Use suitable soil infill and top with sod or seed per local standards

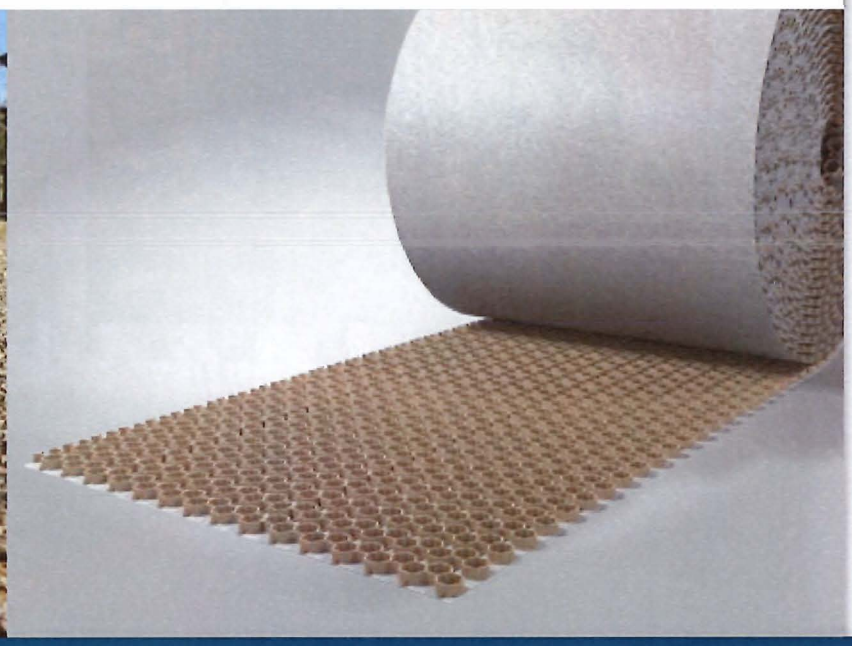
For details & installation instructions visit **ndspro.com/specifications**

EZ Roll™ Gravel Pavers

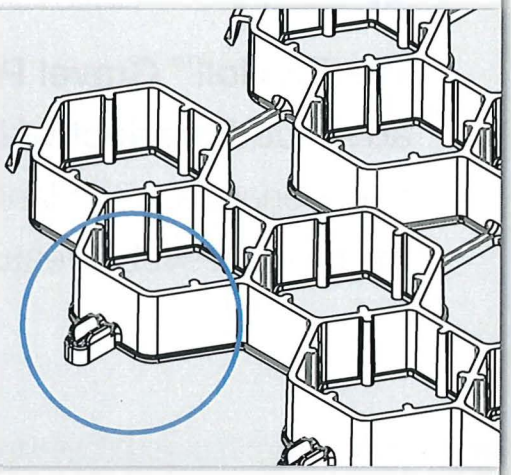
A turf reinforcement, load transferring paving system designed to be placed directly on an engineer specified compacted road base.

This system is designed to transfer vehicle weight directly to the supportive base course and prevent soil compaction. The web of interconnected honeycomb cells provides resistance from vehicular load as well as lateral containment that prevents soil compaction. This system also provides a porous condition that allows rapid absorption of stormwater. EZ Roll™ Gravel Pavers have a compressive strength of 53,683 lbs. in an empty condition and greater than 500,000 lbs. when filled with gravel. The EZ Roll™ Gravel Paver system has been used and accepted across the country for a wide variety of projects including emergency vehicle access purposes.

Additional information, details, and specifications can be found at
http://www.ndspro.com/permeable-pavers/Gravel-pavers/ez-roll-gravel-pavers
For further technical support or assistance, contact: techservice@ndspro.com



Design Theory



The EZ Roll™ Gravel Paver comes in pre-assembled rolls, which means it is easy to roll out, decreasing installation time and increasing efficiency.

EZ Roll™ Gravel has been tested for compressive strength at 53,683 lbs. bare product, meaning that EZ Roll™ does not rely on the fill material for load carrying.

Connections between rows of EZ Roll™ are secure due to unique side-to-side and end-to-end clips that minimize the paver mat movement and separation due to lateral and horizontal pressure. These sturdy locking clips prevent paver displacement or mat failure that could result from traffic load movement or changing ground conditions.

Recommended Use

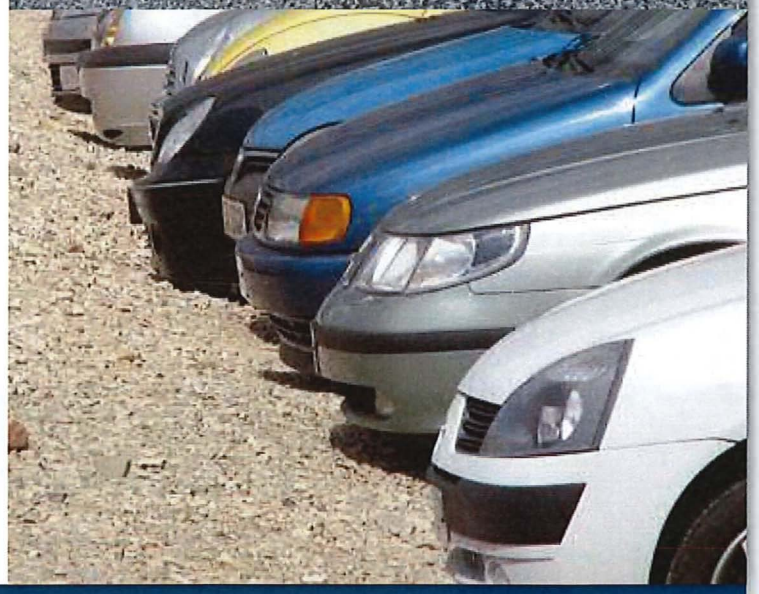
Light Loads:
Golf Cart Paths
Jogging Tracks
Bike Paths
ATV Paths
Equestrian Parks
Trail Reinforcements

Medium Loads:
Roadway Shoulders
Residential Driveways
Parking Lots
Overflow Parking Area
Truck & Cart Wash-Down Areas
RV and Boat Access

Heavy Loads/Fire Lane:
Emergency Vehicle Access Roads
Service Vehicle Utility Roads
Equipment Yards
Consult NDS Design Worx during design phase when the intended use is semi trucks with trailers

Non-load Applications:
Erosion Control on Slopes (staking recommended)
Erosion Control in Swales (staking recommended)

Not Recommended for the Following:
Traffic on slopes exceeding a 10% grade
To support tread driven vehicles



The EZ Roll™ Gravel Pavers from NDS is the latest and most advanced product of its type on the market. NDS has used its years of experience in the landscaping industry to create a product with all of the most desirable features.

Product Specifications

Material. 100% recycled HDPE plastic (50% pre-consumer 50% post-consumer). HDPE is rugged, flexible and ideally suited for outside exposure and longevity. NDS uses UV inhibitors in the polymer structure to prevent breakdown in the strength of the paver.

Color. EZ Roll™ Gravel is available in tan, black, brick red, and gray to provide design flexibility.

Manufacturing. Manufactured in Lindsay, CA.

Recyclability. 100% recyclable. Please recycle whenever possible.

Paver Size. Panels are integrated with crosslinks and clips to form rolls. Part No. EZ4X150 has dimensions of 4' x 150' per roll. Custom size rolls available upon request.

Paver Details. The top surface of the hexagonal cell walls is smooth and devoid of notches or grooves. The bottom surface of the paver mat has over 80% open area for increased permeability.

Chemical Resistance. EZ Roll™ Pavers have superior chemical resistance and are totally inert.

Compressive Strength (Empty Cells): 53,683 lbs.
Compressive Strength (Gravel-Filled Pavers): 500,000 lbs.

Unique Product Features. EZ Roll™ Pavers feature an easy to install top down locking feature. This locking mechanism allows pavers to be installed quickly and easily.

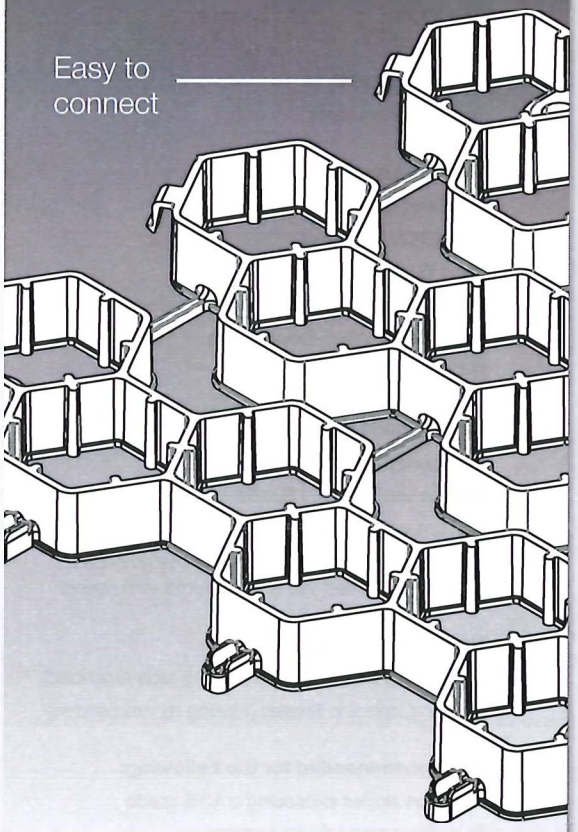
Our fabric is fused to the paver using a proprietary heat-and-pressure-fusion process that is permanent!

Empty cells have a compressive strength of

53,683 lbs.

Product ships in large rolls for easy rollout

Easy to connect



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EZ Roll™ Gravel Pavers are **25% STRONGER** than the competition

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Roll Pavers	Max Load Unfilled (lbs.)	Area (sq. in.)	Max Load (PSI)
NDS EZ Roll™	53,683	144	373
ISI GravelPave²	35,682	144	248

NDS Max load for gravel-filled cells is 500,000 lbs.

ISI GravelPave² is a registered trademark of Invisible Structures Inc.

Case Studies – EZ Roll™ Gravel Pavers

Dallas Arboretum

Dallas, Texas

Daily parking

The arboretum is a high-profile facility in Dallas that generates critical tourism and income to the area. The busy arboretum needed additional parking to accommodate a predicted rise in traffic volume over the next decade and wanted something that would blend in with the natural surroundings while handling heavy amounts of traffic. They also wanted a permeable solution that could mitigate stormwater runoff. EZ Roll™ Gravel pavers were selected for their strength, durability and ease of installation. The project was completed in two phases totaling 185,000 square feet.

Gastonia Readiness Center

Gastonia, NC

Parking and heavy vehicle access

An Army facility, the Gastonia Readiness Center was adding two separate buildings for soldiers and equipment along with a new parking lot for forty vehicles. The new 16,000 sq. ft. lot needed to supply daily parking, but also function as an emergency access lane capable of supporting the weight of National Guard military vehicles. EZ Roll™ Gravel was selected for its strength, permeability and overall aesthetics.

Installation As Easy As 1-2-3

1

Roll it out

Manufactured in pre-assembled rolls for fast and easy installation over prepared base

2

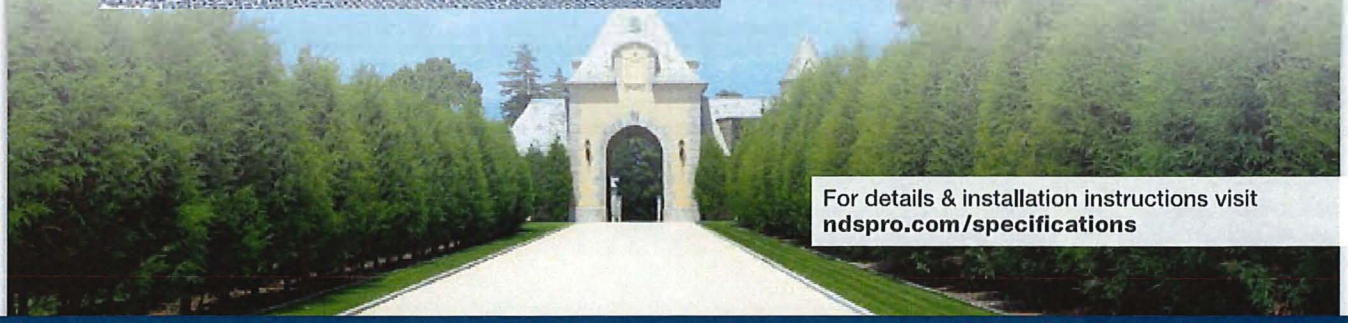
Clip it together

Lateral snap-lock system allows rolls to be connected without any special tools

3

Fill with gravel

Use clean gravel that is uniform in size, 3/8" angular stones work best



For details & installation instructions visit **ndspro.com/specifications**

Contribution to LEED

EZ Roll™ and Tufftrack™ Pavers can be used in a number of categories that contribute points to LEED certification according to LEED v3.

Category: Sustainable Sites

Credit 5.1 Site Development – Protect or Restore Habitat (1 credit):
Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

- To attain this credit, all site disturbances during construction must be limited to within a certain distance from the building perimeter. Use of EZ Roll™ and Tufftrack™ extends the allowed area of site disturbance from 10 ft. to 25 ft., thus providing more area to work during construction.
- EZ Roll™ and Tufftrack™ seeded with native plants in place of asphalt or other non-pervious surfaces will contribute to the overall percentage of habitat restored.
- For projects that qualify for 5.2 (below), use of EZ Roll™ and Tufftrack™ Pavers on a vegetated roof with native or adapted plants can contribute to overall percentage of habitat restored or protected.

Credit 5.2 Site Development – Maximize Open Space (1 credit):
Provide a high ratio of open space to development footprint to promote biodiversity.

- Application of EZ Roll™ and Tufftrack™ provides vegetated open space that will contribute to the open space requirements.
- Use of EZ Roll™ and Tufftrack™ on a vegetated roof can contribute to credit compliance.

Credit 6.1 Stormwater Design – Quantity Control (1 credit):
Limit disruption of natural water hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff, and eliminating contaminants.

- EZ Roll™ and Tufftrack™ can be utilized as part of a stormwater management plan as it reduces impervious cover, increases on-site infiltration, and reduces pollution from stormwater runoff.
- EZ Roll™ and Tufftrack™ can be used to maintain a vegetated roof, which will minimize impervious surface area onsite.

Credit 6.2 Stormwater Design – Quality Control (1 credit):
To limit disruption and pollution of natural water flows by managing stormwater runoff.

- EZ Roll™ and Tufftrack™ can be utilized as part of a stormwater management plan as it reduces impervious cover, increases on-site infiltration, and reduces pollution from stormwater runoff.

Credit 7.1 Heat Island Effect – Nonroof (1 credit):
To reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.

- As open grid pavement systems, the use of EZ Roll™ and Tufftrack™ reduces heat absorption and contributes to the overall hardscaped area calculation for this credit.

Credit 7.2 Heat Island Effect – Roof (1 credit):
To reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.

- EZ Roll™ and Tufftrack™ utilized on a vegetated roof can reduce heat absorption.

Category: Materials and Resources

Credit 4.1 Recycled Content: 10% (post-consumer + ½ pre-consumer) (1 credit):
Increase demand for the building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

- EZ Roll™ and Tufftrack™ is made from 100% recycled HPPE (approximate blend is 50% post-consumer, 50% pre-consumer material). Utilization of this product will increase the proportion of materials used on site that are recycled, and can contribute towards attainment of this credit.

Credit 4.2 Recycled Content: 20% (post-consumer + ½ pre-consumer) (1 credit):
Increase demand for the building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

- As cited in credit 4.1 (above), utilizing EZ Roll™ and Tufftrack™ can contribute to the attainment of this credit, if used in a larger proportion on site relative to the proportion of materials that are not recycled.

NOTES

Permeable Pavers

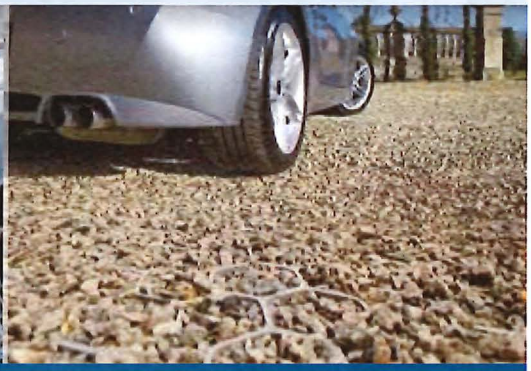
Reinforced Turf & Gravel Systems

High Performing. Proven Durability. Easy Installation.

Tufftrack™
Grass Paver

EZ Roll™
Grass Paver

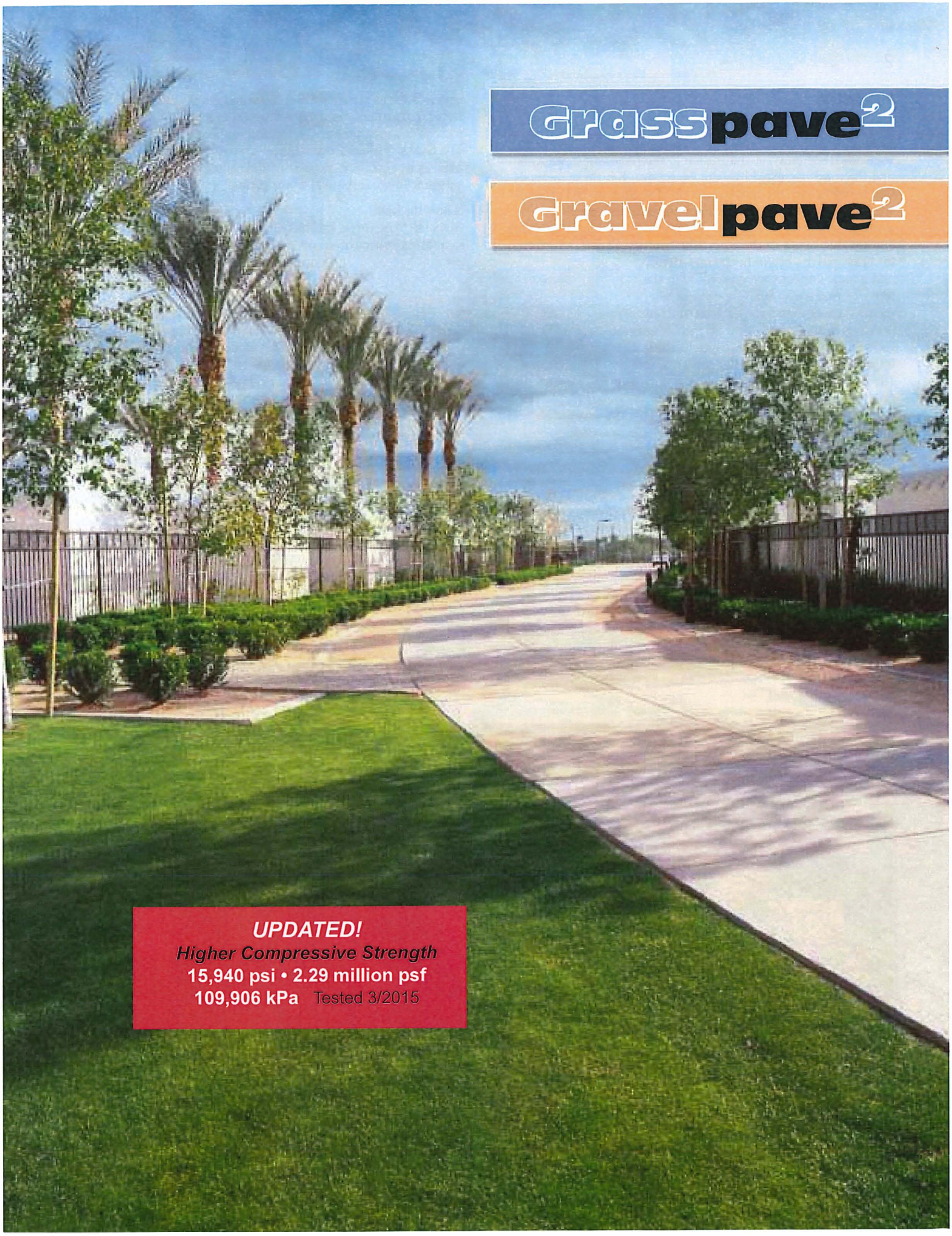
EZ Roll™
Gravel Paver



NDS®
We put water in its place

Visit **ndspro.com** for specs, detail drawings and case studies

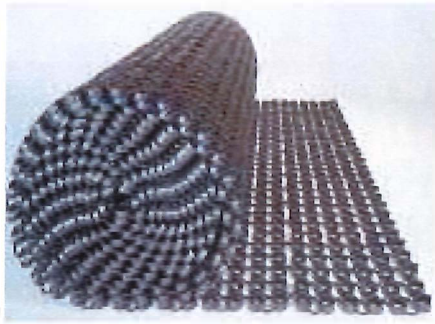
NDS Customer Service
851 N. Harvard Ave., Lindsay, CA 93247
Phone: 800.726.1994 · 559.562.9888
Fax: 800.726.1998 · 559.562.4488


Grasspave2
Gravelpave2
UPDATED!
Higher Compressive Strength
15,940 psi • 2.29 million psf
109,906 kPa Tested 3/2015

Introduction

History of Porous Paving

Pebbles, cobblestones, and wood decking structures have been used since the dawn of civilization to reinforce where we walk and the roads we use. Little did we realize that these methods had benefits over the modern trends of sealing up the ground with asphalt and concrete. Porous, permeable or pervious paving—whatever you prefer—became a method for addressing stormwater issues in the early 20th century. Concrete turfblock for grass paving began in the mid-1940s and plastic versions were invented in the late '70s and early '80s. Great advancements have occurred in pervious concrete, pervious asphalt, and other permeable surfaces. We introduced Grasspave^2 in 1982, improving upon these earlier concepts. In 1993, Gravelpave^2 was unveiled, the only product specifically developed for gravel porous paving. Fast forward to this millennium, and Grasspave^2 and Gravelpave^2 are considered by most, the finest porous pavers developed.



Grasspave^2 large rolls and Gravelpave^2 large rolls (not shown) install quickly and conform to the contours of the ground.

Infiltration

Porous paving allows rainwater to percolate through the pavement's surface and back into the ground (infiltrating), where the water is cleaned and returned to ground water supplies. Porous paving improves upon impermeable surfaces, such as concrete or asphalt, which do not allow for this natural filtration. Rain collects airborne and surface pollutants such as sediment, brake dust, chemicals, vehicle exhaust, oil, salts, fertilizers, bacteria, and animal waste. On impermeable surfaces the polluted rainwater runoff (non-point source pollution) is collected, concentrated, and discharged to downstream waters such as streams, reservoirs, and lakes—our drinking water. This runoff also harms vegetation and wildlife with increased water volumes, velocities, and higher temperatures. The Grasspave^2 and Gravelpave^2 systems protect against this dangerous runoff by processing and cleaning the water, thus safeguarding the natural water cycle.

State of the Earth

Invisible Structures, Inc. has developed an entire line of products to address stormwater and environmental concerns. Rainstore^3, Slopetame^2, Draincore^2, and Beachrings^2 can work in addition to, or in conjunction with, Grasspave^2 and Gravelpave^2 to provide your site, home, or office with stormwater and environmental enhancements. Our products can store and collect rain, provide erosion and sediment control, efficiently convey and deliver water, and protect natural areas.

Advanced Technology

The Grasspave^2 and Gravelpave^2 systems are based on a simple, but impressive technology—a series of rings (cylinders) connected on a flexible grid system. The cylinders are engineered to withstand significant structural loads and the grid provides stability, flexibility, and continuity for large areas. The grid system also has the unique ability to be rolled up for easy shipping, handling and installation.

This engineered design allows for any street-legal vehicle (and sometimes larger) to park or drive on our Grasspave^2 or Gravelpave^2 surfaces. The point load pressure is transferred from the top of the ring, through the fill material and cylinders, to the engineered base course.

Wallace Residence, Savannah, GA—Gravelpave^2 creates a wheelchair-accessible surface by stabilizing gravel and supporting tire pressure. 7% dry cement was mixed with gravel before filling rings. Cover photo: Westin Kierland Resort and Spa, Scottsdale, Arizona—Grasspave^2 fire lane and Gravelpave^2 fire lane (concrete widening).

Pentagon Remote Delivery Facility, Arlington, VA—Grasspave² was selected for the helicopter landing pads (the four grass squares in center) on the largest "green roof" east of the Mississippi.

The ring and grid structure is 92 percent void space allowing for the healthiest root zone for grass (in Grasspave^2) and more decorative gravel (in Gravelpave^2) for some of the most attractive paved surfaces around. Less plastic means more natural looking surfaces. This technology also makes for better runoff coefficients and better percolation rates.

120 psi Maximum on Public Highways!
Even empty, Grasspave^2 and Gravelpave^2 will support 2,100 psi (14,470 kPa)—well over the 120 psi

UPDATED!
High Compressive Strength
15,940 psi • 2.29 million psf
109,906 kPa Tested 3/2015

The heavier a vehicle, the more axles and tires it needs to support the load being carried. Grasspave^2 and Gravelpave^2 will meet and exceed all loading criteria.

Vehicle Loading Examples:

Auto tires: 40 psi
Truck tires: 110 psi
DC-10 tires: 250 psi
F-16 tires: 350 psi
Fire truck with outriggers: 78psi
(An 85,000 lb. truck distributed to four outrigger pads is equal to 21,250 lbs. for each outrigger pad with 12" × 18" surface contact with Grasspave^2.)

All these vehicles are well within our 5,700 psi loading capability. With a sturdy base course design, our rings will easily perform under all conditions. It's also a good design practice to strengthen concrete sidewalks and curbing that will be mounted by fire trucks.

The University of South Alabama, Mobile used Gravelpave^2 in parking aisles and Grasspave^2 in the spaces.

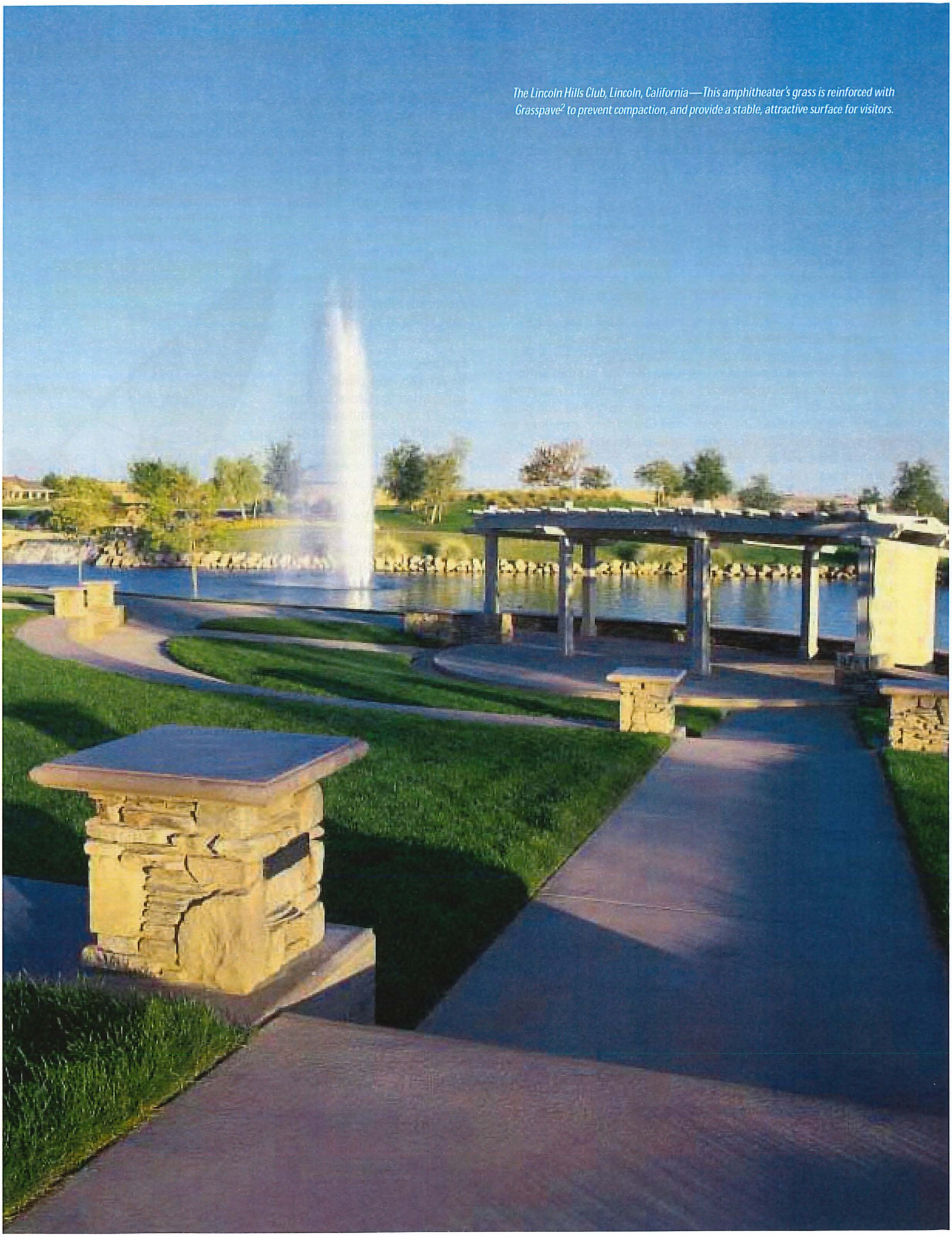
CSI 32 12 43 Flexible Porous Pavers
In 1997 The Construction Specifiers Institute (CSI) came out with a generalized listing (02795) for all porous paving products. However, since performance and application is varied even in the porous paving industry, the 2004 CSI MasterFormat™ has adopted a new number *32 12 43 Flexible Porous Paving*, to recognize that Grasspave^2 and Gravelpave^2 are in a class by themselves.

Best Management Practice
Porous paving is recognized as a Best Management Practice (BMP) by the Environmental Protection Agency, the Center for Watershed Protection, the U.S. Army Corp of Engineers, and countless other federal, state, regional and local authorities. In addition, Grasspave^2 and Gravelpave^2 are often mentioned by name, as the product of choice for many of these agencies.

Applications

Stormwater Management
The Grasspave^2 and Gravelpave^2 systems can easily handle storm water from an intense storm dropping three inches of rain in less than thirty minutes! In one square meter (40" × 40") there are 144 rings, two inches in diameter by one inch high. With one inch of fill in the rings and a standard road base of sandy gravel six

Bowditch Point Regional Park, Fort Myers Beach, Florida—Gravelpave^2 parking bays blend in with the natural surroundings.



The Lincoln Hills Club, Lincoln, California—This amphitheater's grass is reinforced with Grasspave^2 to prevent compaction, and provide a stable, attractive surface for visitors.

inches thick, our porous systems will percolate approximately ½ inch of rain per hour! A seven-inch section can store 2.4 inches of water (about 20 percent void after compaction). Alternatively, hard surfaces, such as asphalt and concrete, shed 95 percent of storm water.

Aesthetics

As a designer, engineer, contractor, or homeowner, you can be sure Grasspave^2 and Gravelpave^2 can deliver a more beautiful surface and add a unique look to a site. Grass simply looks better than asphalt and decorative gravel has been used for centuries in landscaping. Space constraints can be dealt with by combining the beauty of grass or gravel with the utility of paving.

Trees and other vegetation not only survive, they thrive with Grasspave^2 and Gravelpave^2. Porous paving has the ability to deliver water, oxygen and carbon dioxide through the cross section—all essential to root survival. Concrete and asphalt suffocate and starve the root zones of water and air. With Grasspave^2 and Gravelpave^2, you can now design in as many trees and plants as your site will allow. Grasspave^2 and Gravelpave^2 prevent compaction while allowing for ample amounts of water and air. Cars can then drive and park below tree canopies. Saving existing, mature trees is also possible with our products—our structures can come within inches of the mature tree trunk without damage. Our mats have the ability to flex with the tree root growth that would otherwise damage and crack hard surfaces.

Environmental Benefits

Grasspave^2 and Gravelpave^2 not only protect the environment, they enhance it. All of our products are made from 100 percent recycled plastic—plastic that goes into improving the environment and not into a landfill. Through bioremediation, porous pavers have the ability to clean pollutants (heavy metals, 96–99 percent; suspended solids, 95 percent; phosphorous, 65 percent; nitrogen, 82 percent, hydrocarbons, up to 100 percent) out of stormwater. Our products also reduce erosion and soil migration, reduce site disturbance, and contribute to airborne dust capture and retention.

Cooling the atmosphere and reducing the "urban heat island effect" (cities being up to 10 degrees hotter than undeveloped land) are added benefits of Grasspave^2 and Gravelpave^2. Both products can mitigate these increased temperatures. In addition, Grasspave^2 promotes the conversion of carbon dioxide (greenhouse gas) into oxygen and has an "air-conditioning effect."

Driveways

Environmental, economic, and aesthetic enhancements are drawing homeowners and designers to use Grasspave^2 and Gravelpave^2 in driveways. Most residential driveways are good candidates for our porous duo because of the reduced speed and limited frequency of traffic. Our products can add beauty to residential and commercial driveways.

Parking Lots

Parking for churches and synagogues, stadiums, arenas, and overflow at shopping centers, campuses, parks and more are ideal for Grasspave^2 and Gravelpave^2. These sites generally support large numbers of vehicles but only on periodic basis. Stormwater management and green space can be combined with parking, reducing maintenance, real estate, and development costs. A great design idea is combining durable Gravelpave^2 drive aisles with attractive Grasspave^2 parking bays.

Pedestrian, Horse Trails and Bicycle Paths

Garden paths, greenhouse aisles, sidewalks, park paths, and wilderness trails paved with Grasspave^2/Gravelpave^2 provide a stable surface for strollers, bicycles, wheelchairs, and horses. There are no puddles or mud and traction is very good. Tree roots break up hard surface sidewalks, but our mats flex to accommodate such shifts and gradient changes. Plus, with the high proportion of air, roots are discouraged from moving upward. Mountain bikers will not be able to tear up paths reinforced with Grasspave^2/Gravelpave^2. Our products can resist the destructive forces of mountain bikes, allowing your trails to be reopened to bikes.

Fire Lanes

By far, the most common application for Grasspave^2 and Gravelpave^2 installations is for fire lanes. Our long and established history of providing safe, well-constructed fire lanes began in 1982 with our first installation in Snowmass, Colorado, near Aspen Ski Resort. Since then, we have firmly established credibility for this application. Tests have been conducted by several fire departments in Aurora, Colorado and Irvine, California. Nearly every major U.S. metropolitan area has accepted and used Grasspave^2 in a fire lane. You will most likely find a fire lane installation in your area.

All fire fighting vehicles can safely navigate even a wet Grasspave^2 or Gravelpave^2 surface. In a 1983 test this 100-foot ladder truck was lifted off the Grasspave^2 by rear outriggers, and no ruts were caused by either outriggers or tires. The ladder was extended, rotated, and loaded with no depressions in the road surface.

Apartment complex, Concordville, Pennsylvania—Several overflow Gravelpave² parking lots encompass the majority of the perimeter area on the west and south sides of the property. Grasspave² (not shown) is installed on site in two grass fire lanes.

Grasspave^2 Installation—Mats can be rolled out in minutes!

600 m^2 (6,000 sf) per two-person hour! For steps shown below—100 m^2 (1,080 sf) per two-person hour!

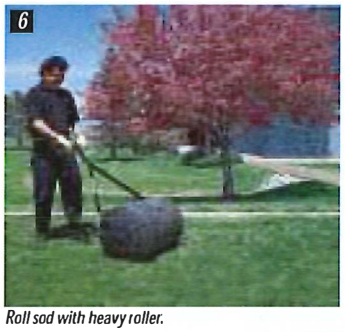
Place and compact sand and gravel base course.

Apply Hydrogrow mixture.

Roll out Grasspave^2.

Fill rings with clean sharp concrete sand.

Hydroseed or lay sod.



Roll sod with heavy roller.

Ready for use after two mowing cycles.

Use a regular lawn mower for maintenance.
Do not aerate!

The Grasspave^2 porous pavement system is comprised of a sandy gravel base course, Hydrogrow polymer-fertilizer mixture, the Grasspave^2 ring and grid structure, sharp concrete sand, and grass seed or sod.

Grasspave² Installation Procedures

This installation section is only intended as an overview. Please review our Grasspave² Technical Specifications (available at www.invisiblestructures.com or call 800-233-1510) for comprehensive installation instructions.

Excavate a space for the base course as determined by site soils and loading requirements. Place and compact sandy gravel which should be a mixture of clean sharp sand and gravel varying in size but not exceeding 3/4 of an inch. To check porosity, use a hose to see that water flows into the base and drains away. Add subsurface drainage as necessary to low spots or locations with poor draining soils. Install irrigation lines and sprinkler heads if necessary.

Apply the Hydrogrow mixture that is included free with your order. Hydrogrow is a mixture of polymer and fertilizer designed especially for our Grasspave² system.

Roll out Grasspave², aligning the side hole fasteners over the side pegs. The warmth of the sun will relax the plastic so it lays flat. Cut the grid between rings using pruning shears. Incorporate the cut pieces in other areas, as needed, keeping the distance between the rings uniform.

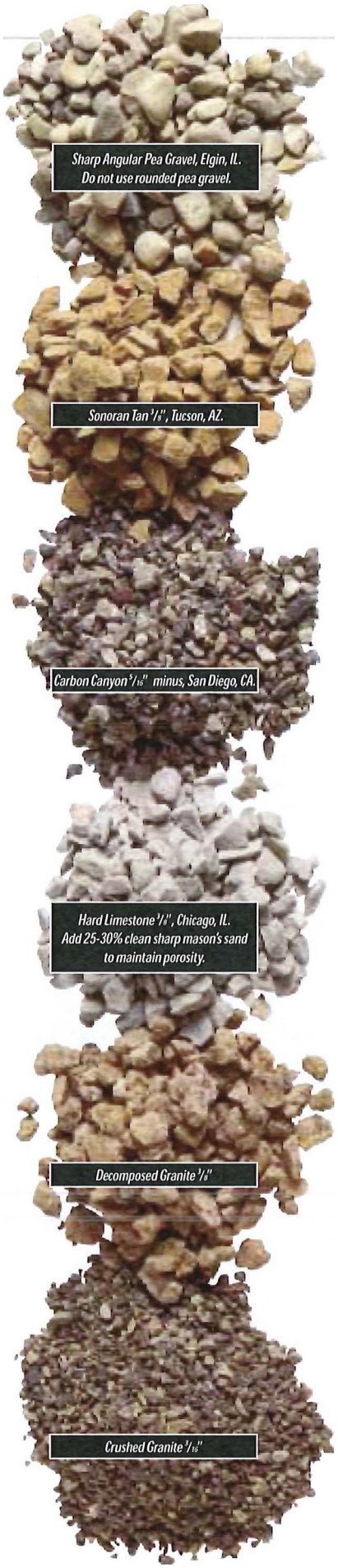
Fill rings with clean sharp concrete sand (AASHTO M6 or ASTM C-33) using large rakes and brooms so that the tops of the rings show when done.

Lay turf over the rings. On warm days, wet the sand first to lower sand temperature and provide moisture for grass roots. Seeding and hydromulching is also an accepted vegetating method at this stage. Repeated hydromulching/seeding may be necessary.

Roll sod with heavy roller to eliminate air pockets and make sure roots are in contact with the sand fill. Water lawn as usual according to climatic requirements.

Whether the area has been seeded or sodded, wait to drive on grass until two mowings have been completed, by which time the root system will be established and the sod pieces locked into place. In an emergency such as the need for fire truck access, grass may be driven on immediately after installation.

Use a regular lawn mower for maintenance. There should be no paver parts protruding through the surface that would damage mowers. Do not aerate!




1

Place and compact sand and gravel road base.


2

Roll out Gravelpave², aligning the snap fit fasteners.


3

Secure mats with anchors provided (size and type may vary).


4

Fill rings with clean gravel.


5

Compact gravel with vibrator roller or flat plate compactor (not shown).

Gravelpave² Installation—

Gravelpave² Size/Shape Fill Requirements

You will need 1" of gravel fill, compacted. Be careful to order enough for the compaction process and choose a gravel size that will nest well into the rings. We have found that 3/16" minus crushed stone and sometime 3/8" with limited small sharp screenings (#40 to #100 screen) works well. Washed gravel will roll within the rings and will also "roll about." For this reason, we do not recommend pea gravel, even though it is often very attractive. A visit to your local quarry is suggested. We have found that some geological areas of the United States have limited types of sharp gravel available. It has been necessary to import gravel from a neighboring state, but remember the amounts are relatively small—the top one-and-a-quarter inch of the cross section. Gravel should be as free of fines as possible. To maintain porosity, avoid soft stone materials with low durability that will break easily.

Other Fill Materials for Gravelpave²

Please ask our staff for assistance with this category since it is use-specific and often experimental. Ground rubber, crushed glass, crushed brick, and many other materials can be useful as attractive fill materials for various applications. Thermoset (epoxy, polyurethane, etc.) binders may be cost prohibitive for most projects, but offer unique design possibilities, including clarity, color enhancement (wet look), flexibility, and durability.

Our technical support staff will assist with selection of gravel sources. The photographic samples shown on this page will help you narrow your gravel choices. Should you have questions concerning the selection, please submit a small sample for approval prior to specifying or securing the materials.

Mats can be rolled out in minutes!

Gravelpave² Installation Procedure

This installation section is only intended as an overview. Please review our Gravelpave² Technical Specifications (available at www.invisiblestructures.com or call 800-233-1510) for comprehensive installation instructions.

Prepare sandy gravel base course to a depth as determined by a soils engineer. Compact with a vibrating plate compactor or use a heavy motorized roller for large jobs. To test porosity, water with a hose and check to see that water drains readily through the base course before installing the Gravelpave² mats.

Roll out mats with the grain (in the same direction) so that the snap fit fasteners can be used with neighboring mats. To fit around boxes and curbs, cut the grid between the rings with pruning shears and scissors or a small portable electric hand saw.

Fasten the mats together using the snap fit fasteners that are molded into the product inserting the prongs into the rectangular openings. Tuck the fabric underneath the fasteners to keep joints closed. A quarter-inch nut driver head (6 mm) fits nicely over the fastener to compress the pieces together. A piece of lumber placed under the Gravelpave² mat will provide stability to aid in fastening.

Supplied anchors must be used to secure the mats to the base. Hammer anchors with washers at a rate of one anchor per six rings in both directions. Use extra anchors around the perimeter of the Gravelpave² install and in high traffic areas. Reciprocating hammers can be used to speed up the anchoring process. Anchors should be placed inside the rings as close to the center as possible. Begin anchoring from one corner in a radial pattern.

Gradually place gravel fill (see suggested fill material on facing page) into rings by using a front-end loader and shaking out the fill as the machine drives forward. Carefully lower the bucket when empty and back up while dragging it *above* the rings to smooth out the gravel, finishing with a stiff broom. Wheel barrow and shovel works well for small jobs. Contractor tip—you can store excess material for future maintenance, top dressing as may be necessary. Use rakes and/or push brooms to distribute the gravel fill to a level slightly above rings so that compacting the fill will not uncover the rings.

Use a vibrating plate compactor or large driving roller again to compact the gravel fill. Additional gravel may be necessary to finish filling the rings. Compact again until the material appears solid in the rings. Wetting the gravel may help it to interlock.

Drive on the installation when finished. If car tires make a pattern, there may be too much gravel or it may need additional compaction. It is expected that tops of the rings may be visible. If sides of the rings show, then add more fill material and repeat the compaction process.

Golf Industry

Gravelpave² and Grasspave² golf cart paths give the look of a natural path through trees, along fairways, and around greens. The flush surface requires no trimming or edging. Traction is excellent with Gravelpave² and Grasspave² traction is slightly better than grass. Grasspave² and Gravelpave² can enhance your golf cart staging area, pedestrian traffic area, parking lot, road shoulder, and maintenance yard.

Automobile Dealership Displays

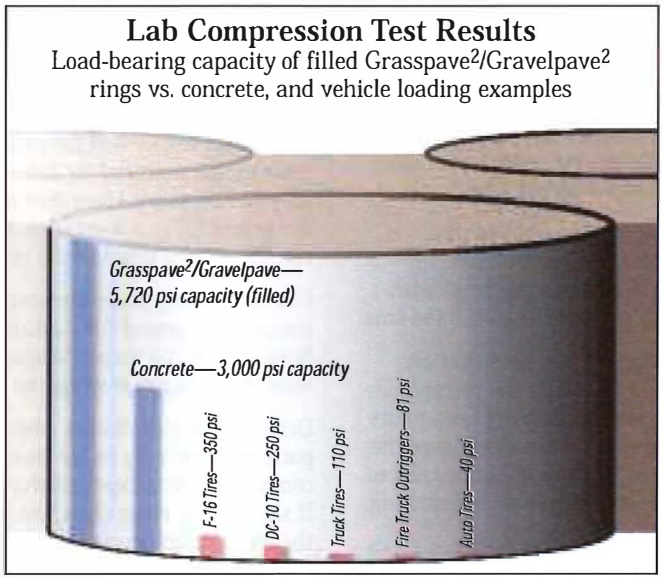
Car dealerships have discovered that Grasspave² and Gravelpave² are perfect for automobile display areas. Dealerships now have an option when it comes to adding paved areas for car transport and display. Dealerships like the "soft" attractive look grass and decorative gravel provide.

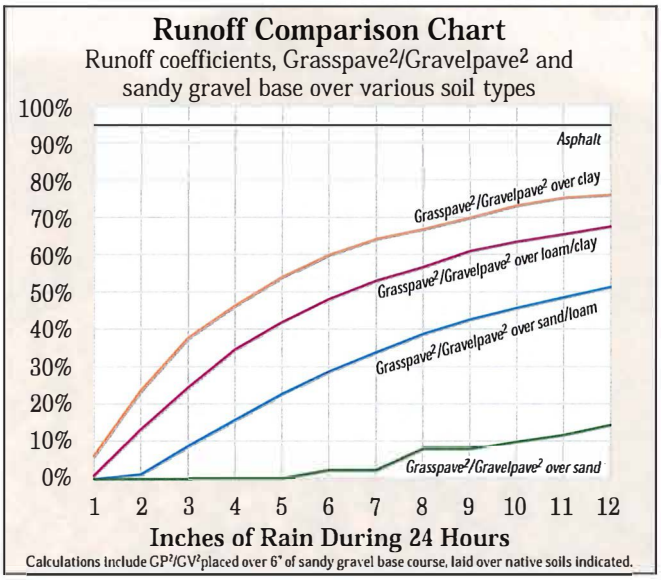
Utility and Maintenance Vehicle Access

Providing your site with important utilitarian functions without compromising beauty is simple. Grasspave² and Gravelpave² can incorporate a structural road without interrupting your landscaping. No obtrusive concrete or asphalt access roads are necessary to get to window washing areas, pump stations, microwave towers, tanks, or electrical boxes.

Unique Applications

Our mats are installed in some unique and interesting places: Helicopter landing pads, race car display areas, outdoor amphitheater seating, under picnic tables, under concrete pavers (support), airplane display and transport, cemetery marker reinforcement, eave drip lines and more. Installations are not limited to traditional paved areas.





Grasspave² Characteristics

Ring and Grid Structure

Grasspave² is by most accounts the best flexible grass paver made today. Its unique ring and grid structure allow for flexibility, stability, and exceptional grass growth. With 92 percent void space for healthy roots and 100 percent grass coverage, Grasspave² is the industry's preeminent choice. Our installations are hard to find because they are invisible! With so little plastic near the crown of the grass, the blades of grass are not smashed by product. Root development is not interrupted from spreading laterally. The rings are strong and rigid, keeping grass root systems protected from harm. The roots grow directly downward, deep into the sandy gravel base course.

Large Rolls

Our patented systems have a shipping, handling and installation advantage as well—large rolls. Our standard roll size (model 2020) covers 431 sq. ft. (40 m²) and weighs 192 pounds (87 kg). Other roll sizes are available. Installers of our products have repeatedly commented that they enjoy the easy installation. Rolling out Grasspave² is similar to rolling out carpeting and coverage is fast and efficient. The mat system can be easily cut to fit around trees, irrigation, curbing, or other terrain. The rolls have snap-fit connectors to attach to adjacent rolls, making one unified, contiguous system. This unified mat system adds stability and continuity in design. Grasspave² can just as easily be snapped to Gravelpave² to add stability and product variation.

Hydrogrow

Another reason Grasspave² is the industry leader is the addition of Hydrogrow soil amendment, which is supplied with your order. Hydrogrow is engineered to help grass grow in our sand based root zone. The results are amazing and our Grasspave² areas often look healthier than surrounding turf. By using this special mixture in the sand, porosity will be maintained, turf will be attractive, and aeration will not be necessary.

Sand Fill

Grasspave² is the only grass paver on the market specifying sand as part of its cross section. Sand is the best medium to provide water and air to the roots and still provide high compressive strength. The United States Golf Association uses sand for every USGA golf course and nearly every professional and collegiate turf athletic field uses a sand cross section as well. Topsoil (or other organics fill material) in the rings will eventually compact and damage the root zone. Sand negates the need for mechanical aeration, which can damage Grasspave² and other grass pavers.

Strength When Installed

When installed over a thick base course and compacted to 95 percent modified Proctor, sand-filled rings can support 5,700 pounds per square inch (psi) without deflection or compromise to safety. The cylinder is the strongest shape to support compressive loads because it has no corners. Supporting heavy loads with the rings allows us to use less plastic in the product creating a 92 percent void area for root development, combined with strength! Less plastic means a lower cost for you.

Fort Shantok State Park, The Mohegan Tribe, Uncasville, CT—Low-maintenance parking lot stable for cars, strollers, and wheelchairs. This lot is plowed in the winter.

Traffic Frequency

Grass as a surface material can withstand from two to six (varies with grass species and environmental conditions) trips daily over the same spot. This suggests that most parking applications we pave with asphalt today could be paved with Grasspave² instead. Vehicles can remain parked on grass for extended periods of time, provided some relief can be given for a few days for the grass to recover.

Lifespan

Grasspave² has a projected lifespan of 60 years. Compared to asphalt with a lifespan of 15 years; and concrete with a lifespan of 25 years, Grasspave² will save you money on replacement costs.

Irrigation

Grass needs water and you may need to have irrigation installed. Grasspave² has a sand based root zone which usually requires slightly more water than a normal topsoil or organic root zone. If golf courses in your area use irrigation systems, you probably should in your Grassapave² installation.

Standard colors include: Tan, Black, Pewter Grey, Terra Cotta.

Gravelpave² Characteristics

Fabric, Ring and Grid

When we developed Gravelpave² in 1993, our goal was to provide designers a second option for a porous pavement that can tolerate high frequency and low-speed traffic. By molding our ring and grid structure onto a non-woven polyester filter fabric, we were able to create a new product that contains gravel and prevents particle migration and rutting.

Invisible Structures—Standard Product Roll Sizes

	Width		Length		Diameter		Area		Weight	
Model	m	ft	m	ft	m	ft	m²	ft²	kg	lbs
1010	1	3.3	10	32.8	0.5	1.7	10	108	22	48
1020	1	3.3	20	65.6	0.8	2.7	20	215	44	96
1520	1.5	4.9	20	65.6	0.8	2.7	30	323	65	144
2020	2	6.6	20	65.6	0.8	2.7	40	430	87	192
2520	2.5	8.2	20	65.6	0.8	2.7	50	538	109	240

Rolls can be installed manually (2 people advised). Rolls apply to Grasspave², Gravelpave², Draincore², and Slopetame².

Gravelpave² is the only system specifically designed for aggregate containment porous paving. The cylinders displace the load onto an engineered base course and hold the decorative gravel in place. The fabric keeps the top-dress gravel from compacting into the road base, acts as a weed and vegetation barrier, and suppresses dust.

Traditional pavements, including gravel roads, are designed to shed water and keep it away from the pavement's cross-section. Gravelpave² is designed to do the opposite—welcoming water down through the system. Plus, Gravelpave² will not rut, wash-board, or puddle like traditional gravel roads.

Snap-Fit Fasteners

Designed into Gravelpave² is a snap-fit fastener, a two-pronged arrow that fits into a rectangular slot. Simply push the slot over the prongs to easily snap together panels of Grasspave². To take them apart, just squeeze the prongs together and lift off the slot. Should the fasteners of one mat not align over the distance of another mat, then anchor pins (or eight inch ring shank nails and large washers) can be used to secure the mats along the seam. Forcing the alignment can cause the mats to ripple and not lay down evenly.

Traffic Frequency

Gravelpave² has no limits on frequency or duration of traffic on the system. Park or drive as often as you like on Gravelpave². However, speeds should be kept at or below about 20 mph (30 km/h).

Durability

Grasspave² and Gravelpave² are made from flexible High Density Polyethylene (HDPE) plastic with UV inhibitors, which withstands repeated freeze-thaw cycles and continuous subzero temperatures without cracking. HDPE resists aggressive chemicals such as road salts, motor oils and fuels. HDPE is highly abrasion-resistant and is unaffected by extremes in pH. A well-maintained Gravelpave² installation will last 25 years in most climates.

Aesthetics

Part of what draws many designers to use Gravelpave² is the ability to have an area maintain a natural look. Many times native soils or gravel can be used as fill material, complementing surrounding areas. Gravelpave² is available in four standard colors—black, tan, gray, and terra cotta (custom colors are available at additional cost). Ring colors are intended to blend with the gravel color so they will be less visible should some portion of the rings show. A small amount of excess stone fill should be left above the top of the rings to provide visual cover and additional UV protection. This excess will migrate, but usually not very far.

Size and Shape Requirements for Gravel Fill

You will need one and a quarter inch (3.2 cm) of gravel fill, before compaction. After compaction the gravel should be only be slightly higher than the rings (⅛ inch, 3 mm above). The following criteria for gravel fill will make the most of the systems performance:

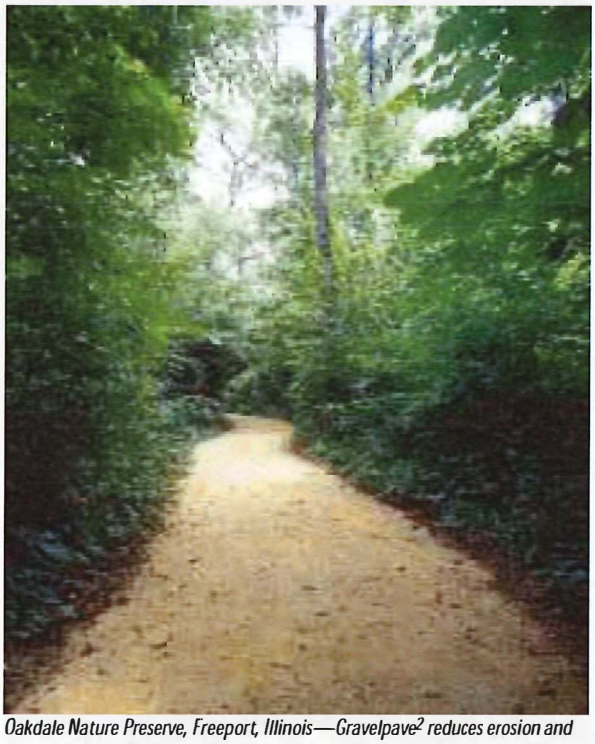
- Hard—resistant to breaking, crushing or crumbling
- Sharp and angular (do not use rounded pea gravel)
- Clean, washed (free of fines)
- Size 3⁄16 to ⅜ inch (5 mm to 1 cm)

Other fill material may be used in certain situations, but may be considered use-specific or experimental. Please consult with our technical support staff regarding fill material not meeting the above criteria or for installations requiring "binders."

Denver Tech Center Corporate Client, CO—Curving Grasspave² firelanes around both buildings lends opportunity for private outdoor lounge area for employees who can also enjoy the garden view from their office windows.

Dust Suppression

Dirt and gravel roads have the potential to kick up dust and dirt when traversed. Many communities have regulations limiting or eliminating gravel surfaces from new construction. Rest assured, if you design a Gravelpave^2 surface you will be getting a virtually dust-free surface. The clean and washed fill material required to fill the rings will not have any more dust than an asphalt-paved surface. Gravelpave^2's geotextile fabric will prevent the dust-sized particles contained within the base material (existing gravel surface or dirt), from being displaced by moving tire or wind forces.



Oakdale Nature Preserve, Freeport, Illinois—Gravelpave^2 reduces erosion and rutting in this ADA accessible trail.

Industry Advantages

Economic Advantages

Whether you are an engineer, architect, landscape architect, contractor or homeowner you will be concerned with the cost of you project. Grasspave^2 and Gravepave^2 will save you money. Our products will save on design costs, installation costs, component materials, maintenance/operations expenses and lifecycle costs. We can find a way to reduce your site expenses with our porous pavers.

When designing, you may be able to eliminate or reduce stormwater filters, detention basins, conveyance lines, modifying grading requirements, or many other "necessities" associated with asphalt or concrete. A great deal of your stormwater mitigation plan can be built into Grasspave^2 and Gravelpave^2.

Installers have been astounded by the speed and efficiency for which large areas can be accommodated by our large rolls. Unrolling our mats, snap fitting, and cutting is easy and requires no special machinery. Please view our technical specifications (from www.invisiblestructures.com, call 800-233-1510, or available through our partner network) for the installation procedure. A brief installation overview is also on pages 8 and 10).

In addition to cost savings in the design phase, you may be able to eliminate other components during installation such as root protection for trees, grates, manholes, curbing, and tree and vegetation removal costs.

Maintenance and operations costs are significantly reduced over asphalt and concrete surfaces. A. (Andy) E. Lindsey, Director of Grounds Maintenance, University of South Alabama, in his written analysis dated February 18, 1999, compared the cost of our porous systems to asphalt pavement using historical data from university records. The conclusion was a $56,000 savings over 20 years, by using Grasspave^2 and Gravelpave^2.

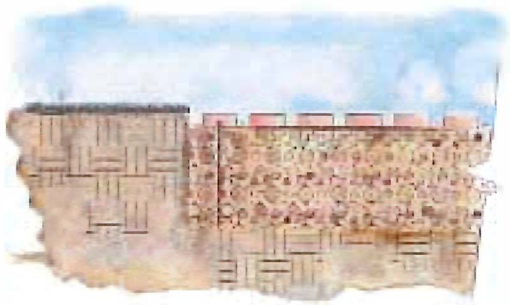
Our products can save you the most money by combining your surfaces' uses into one area. Multiple surface use means savings on real estate, design costs, maintenance, insurance and more. You can have a fire lane that doubles as "green space" for employees or visitors, combine a parking lot with a bio-swale and stormwater mitigation system, and expand your lawn into the driveway. The Grasspave^2 and Gravelpave^2 installations at Reliant Stadium, Houston, Texas, pull quadruple duty, providing over seven acres of parking, stormwater mitigation, required "green space," and an outdoor festival site which generate additional income.

As mentioned above, Grasspave^2 and Gravelpave^2 have a longer lifespan than asphalt. Compound the above savings with the longer lifespan, and you can have a lifecycle cost which can save thousand of dollars on even moderately sized installations.

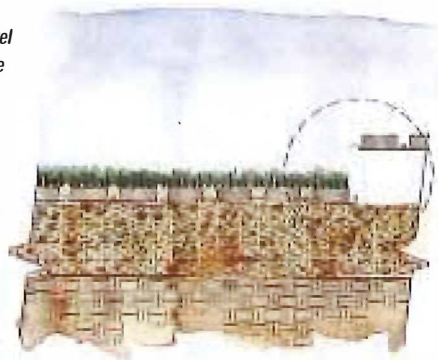
Competitive Advantages

Our porous pavers not only have advantages over impervious surfaces, we are proud to compete with any other plastic porous pavers manufactured. Our products are the strongest on the market 5,721 psi installed (39,273 kPa, 823,844 psf or 7,414,416 psy), or 2,100 psi empty. Grasspave^2 and Gravelpave^2 have

Compacted sandy gravel road base placed above compacted subgrade, 95% modified Proctor density. Gravelpave^2 rolls are laid, pinned, and filled with clean, sharp gravel.



For Grasspave^2: Compacted sandy gravel road base placed above compacted subgrade, 95% modified.



Reliant Stadium at Reliant Park, Houston, TX—The largest engineered grass porous system 30,800 m² (317,000 sq ft) provides parking, stormwater management, and a cool surface for festivals and concerts.

92 percent void space for the best root development and grass coverage (Grasspave^2) and the most volume available for desired fill (Gravelpave^2). Most other plastic pavers come in rigid unit blocks, which are cumbersome to install and difficult to cut and shape. Grasspave^2 and Gravelpave^2 rolls are considered the favorite to work with by installers, for the flexibility, continuity, and speed of installations. Grasspave^2 is the only product on the market specifying sand infill for the grass roots. Sand is recommended as the infill of choice for grass pavers by Professor Bruce K. Ferguson, Univ. of Georgia, author of the book, "Porous Pavements."

Vancouver City Works Yard, Vancouver, British Columbia—main staff parking lot, done in Gravelpave^2.

Fire lane, San Mateo, CA—Many native grasses and other attractive vegetation can be grown in Grasspave^2.

Competing Technologies

Porous paving technology has made great strides not only in flexible plastic pavers but in other areas as well. Permeable asphalt, permeable concrete, interlocking unit blocks, reinforcement mats, and concrete grid pavements, have all improved and advanced to meet the growing demand for environmentally friendly technologies. It is Invisible Structures' firm belief that you should use porous paving, even if it is not our product line, whenever possible. The more you use these technologies, the better accepted they become: If you have to pave, porous pave!

Invisible Structures also contends that while these competing technologies have their place, in most instances, our Grasspave^2 and Gravelpave^2 systems outperform, last longer, require less maintenance, look better, and are easier to install. Check with our technical specialists at 800-233-1510 for the latest data.

Designing for Grasspave^2 and Gravelpave^2

Design for Use

There is an area in your development, site, or home that will most likely benefit from Grasspave^2 and Gravelpave^2. We advise that you take a look at proper use patterns, site conditions, and other specifications to get full advantage and long life out of our products. *Invisible Structures, 800-233-1510, is available for preliminary design assistance and consultation. Please note that other porous paving systems are NOT interchangeable with Grasspave^2 or Gravelpave^2, consult our technical specifications for full installation instructions.*

Considerations for Design:

- High use, low speed, and unlimited traffic volume is optimal for Gravelpave^2
- Low to moderate use, low speed, with recovery time is perfect for Grasspave^2 or Gravelpave^2
- Keep the porous paving area free of sediment and erosion from adjacent areas as they can cause drainage and aesthetic issues. Extra care should be taking for use in swales or berms.
- Slope should be considered. Grasspave^2 and Gravelpave^2 perform the best for all vehicles when the slope is no greater than 8 percent. Light vehicles (golf carts), bicycles, and pedestrian areas can have up to a 20 percent slope. Grasspave^2 in fire lanes should not exceed five percent (consult your local fire departments).
- Check the permeability of existing underlying soils. Percolation rates should be .64 cm to 1.3 cm of water per hour (EPA guidelines).
- The water table should be about three feet (approx. 1 m) below base course in most instances.
- Bedrock should not be closer than two feet (0.6 m) below base course.
- Avoid use of Grasspave^2 and Gravelpave^2 in areas where high-speed acceleration or braking and turning occur. Examples are entrances and exits to parking lots that connect to higher speed roads.

If your site varies from these conditions, please consult ISI directly, 800-233-1510, as some conditions can be overcome with design and component adjustments.

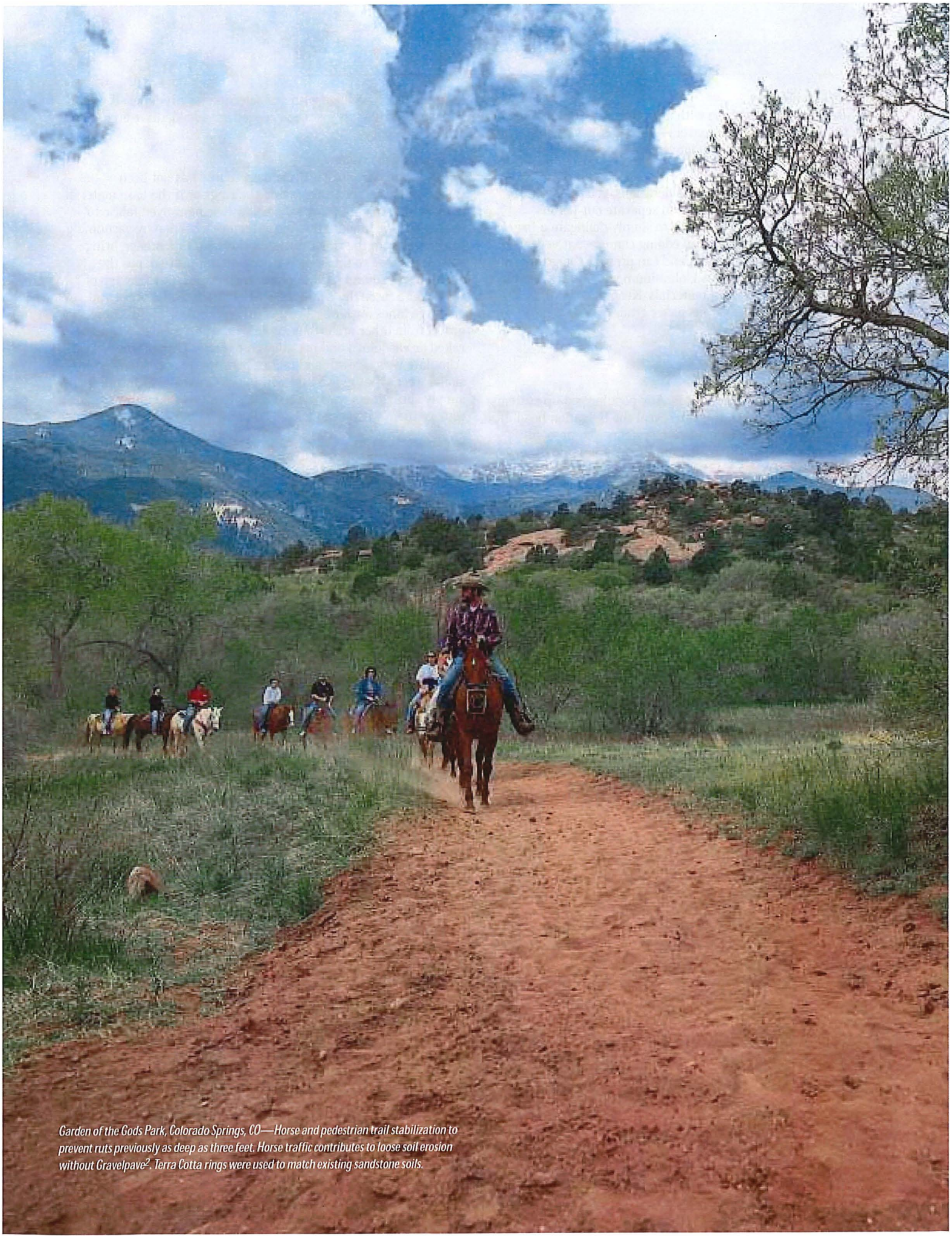
Base Course Design

Calculating the depth and composition of materials for the base course incorporates the same design criteria as for other pavements:

- Load-bearing capacity of native (or fill) subsoil,
- Plasticity or impact of moisture on strength and longevity,
- Frostheave potential, and
- Traffic load, frequency and/or duration.

Sample Base Course Depths

Please consult with a soils engineer for site-specific base requirements. Generally, the depth that is used under asphalt will be the requirement under Grasspave^2/Gravelpave^2. Golf carts and pedestrian traffic may require nothing over sandy gravel soils, and just two to four inches of base course (5–10 cm) over very weak soils. Cars usually need a six- to eight-inch base course (15–20 cm). Buses, trucks, and fire engines can easily require eight to 12 inches (20–30 cm) or more. The use of geotextiles, below the base is not required, but will prevent integration with subsoils and is strongly advised in areas of clay or silt soils and frost heave. *Do not use 100 percent limestone base as limestone will compact and become impervious—If limestone must be used, mix with 25–30 percent sand (AASTO M6 or equal).*



Garden of the Gods Park, Colorado Springs, CO—Horse and pedestrian trail stabilization to prevent ruts previously as deep as three feet. Horse traffic contributes to loose soil erosion without Gravelpave^2. Terra Cotta rings were used to match existing sandstone soils.

Bedding Sand Not Necessary

Do not use a sand setting base with our products. Unlike concrete pavers, bricks, and other rigid pavers—our Grasspave^2 and Gravelpave^2 are flexible and do not require sand to level.

Edge Protection

For aesthetic and maintenance considerations, you may want to design in a durable edging material to separate our porous pavers from adjacent areas of turf or to simply delineate a fire lane or path. With Gravelpave^2, an edging can prevent vegetation from encroaching onto the system and can prevent the gravel fill from migrating at the edge. Steel, aluminum, wood, brick, or concrete are all acceptable edging materials. Keep the edging flush or slightly higher than the porous paver grade.

Maintenance and Operation

Grasspave^2 Maintenance

Irrigation is required in dry climates. Any popular pop-up system can be used. Simply cut out rings to reveal the irrigation head. If golf courses in your area use irrigation systems, you probably should in your Grasspave^2 installation. Be careful not to overwater as this will encourage shallow root development.

Fertilize once a year with an NPK slow-release fertilizer that contains trace elements. There are many brands on the market. Do not aerate! You'll end up with product damage. When installed using sand in the rings, there will not be a compaction problem. Be careful not to use clay-based sods in pedestrian or vehicular traffic areas—use sandy soil sod, or seed and mulch. There seems to be no problem with sod selection for fire lanes. If the Grasspave^2 area has just been seeded or sodded, drive on it only in an emergency.

Gravelpave^2 Maintenance

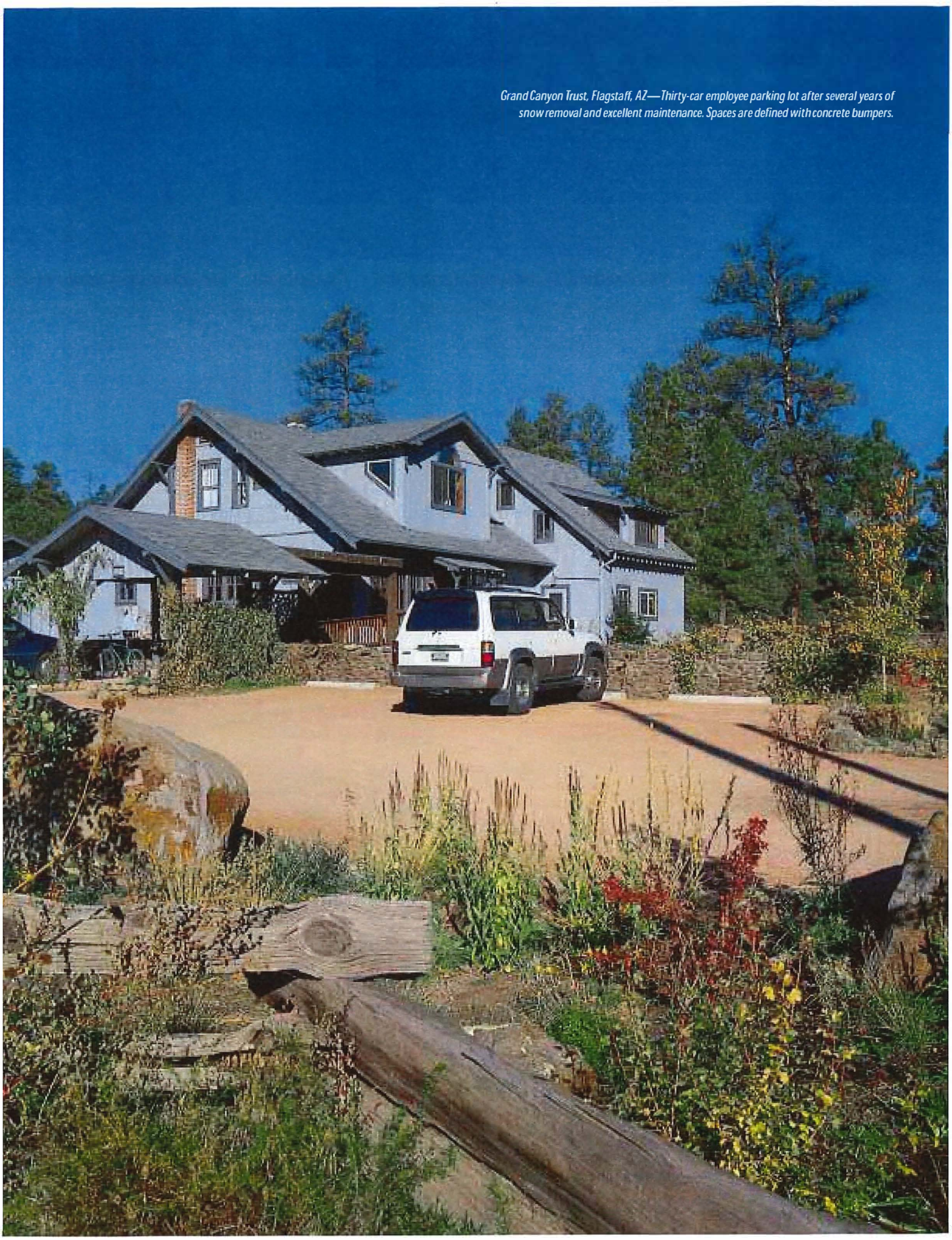
Potholes will only appear if the base course has not been compacted properly before laying the rings or if the base material is allowed to mix into clay soils below (use nonwoven fabric to keep separate). Should this occur, remove a section by vacuuming the gravel from the rings, unfasten the snap fit fastener, bring the base course to the proper grade and compaction, put the Gravelpave^2 square back in place, anchor, and fill to the top of the rings. Seasonally check the rings in high-traffic areas and entrance lanes for lower levels of fill and replace by sweeping gravel from other areas to bring it level again. Leaves should be raked or vacuumed and not allowed to decay. Organic matter will stimulate weed growth and reduce porosity. To attack any occasional weeds that may locate within the Gravelpave^2 installation, simply spray them with a weed killer (such as Roundup™) and remove them when dead.

Cold Climate Concerns

Porous pavement thaws faster than conventional pavements because it allows melted water to flow directly through the pavement, increasing the temperature in the cross-section.

Grasspave^2 and Gravelpave^2 are made from flexible High Density Polyethylene (HDPE) plastic with UV inhibitors, which withstands repeated freeze-thaw cycles and continuous subzero temperatures without cracking.

Private Residence, Houston, TX—Grasspave^2 supported grass sections in this custom home driveway.



Grand Canyon Trust, Flagstaff, AZ—Thirty-car employee parking lot after several years of snow removal and excellent maintenance. Spaces are defined with concrete bumpers.

Fire departments usually require you to plow snow that is over three inches deep. (7.5 cm). Consult with your local fire department for their guidelines.

Educate your snow removal crew to take care not to have the plow blade make contact with the Grasspave^2 or Gravelpave^2 systems. Experienced snowplow drivers can leave a thin layer of snow on the systems or they can attach skids (¾ inch—2 cm) to the bottom of the blades.

Sales and Technical Support Partners

Invisible Structures, Inc. welcomes the opportunity to review designs and answer technical questions. Design details, technical specifications, white papers, and other support material may be downloaded from our web site. See a comprehensive list of project profiles and case studies at www.invisiblestructures.com.

In addition to the high-quality, professional, experienced staff at our main headquarters in Colorado, we have excellent partners representing their geographical areas. They are prepared to assist you locally, at all levels, with your project needs. Please contact us or check our web site for your partner name and information.

Contact Information

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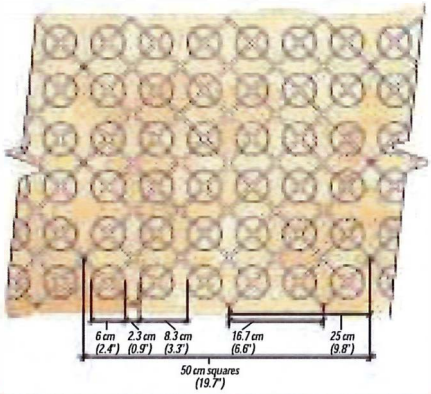
800-233-1510 overseas and locally 303-233-8383
Fax 800-233-1522 overseas and locally 303-233-8282
www.invisiblestructures.com
email: sales@invisiblestructures.com

Grasspave^2 is used as a cool, stable surface for picnic tables at a community pool.

City of White Rock Operations , White Rock, British Columbia—Gravelpave^2 is used in the main drive aisle of the works yard and Grasspave^2 is used for the parking bays.



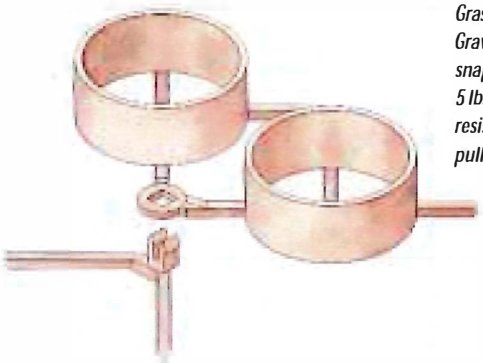
Gravelpave^2: Available in several roll sizes.

Squares weigh 1.97 kg (4.34 lb) each.

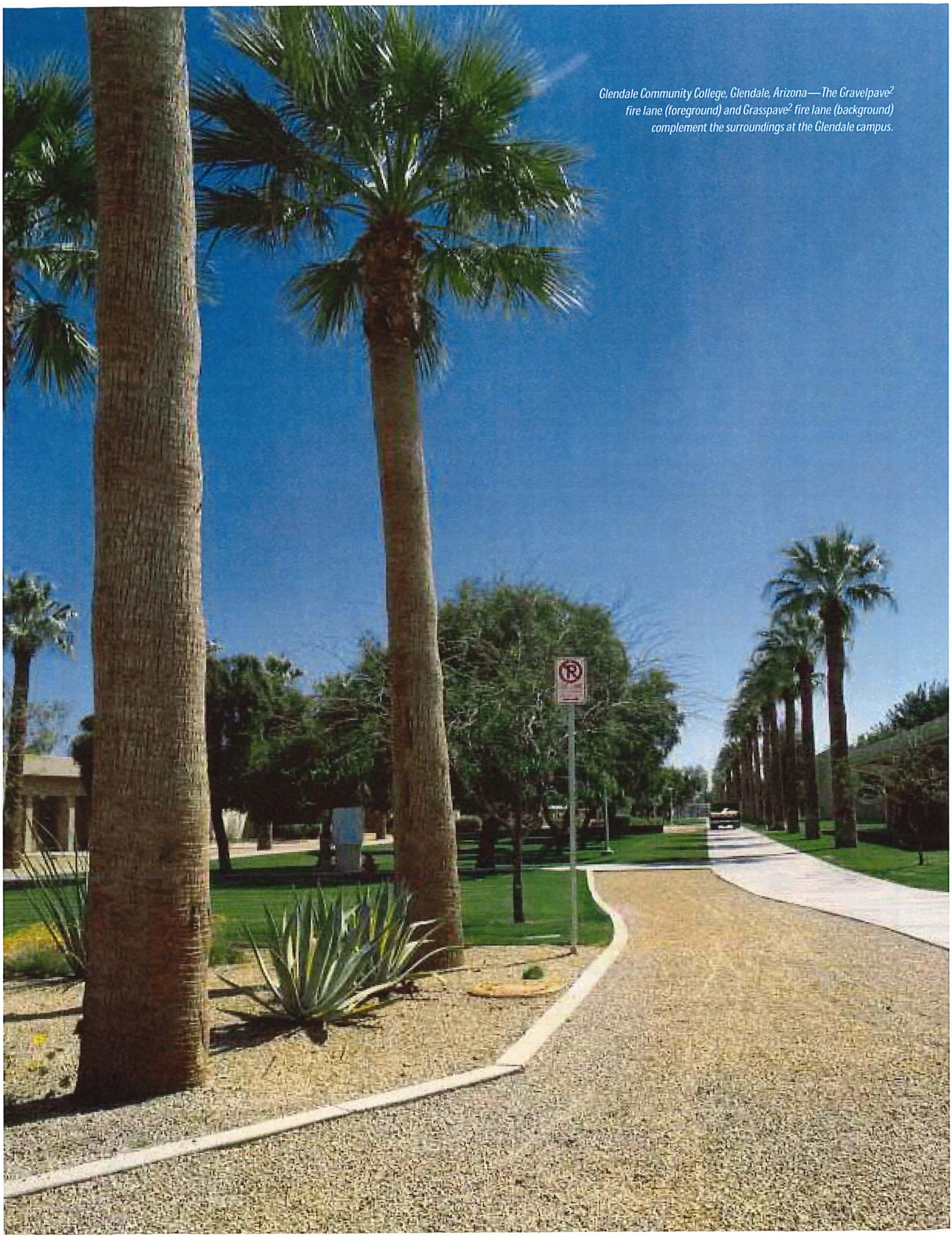
Colors: Cashew Brown, Black, Pewter Grey, Terra Cotta.

Resin: HDPE.

Strength: 402 kg/cm^2 (5,720 psi).



Grasspave^2 and Gravelpave^2: Reusable snap connector requires 5 lbs to connect and resists 70 lbs of pull-apart force.



Glendale Community College, Glendale, Arizona—The Gravelpave² fire lane (foreground) and Grasspave² fire lane (background) complement the surroundings at the Glendale campus.

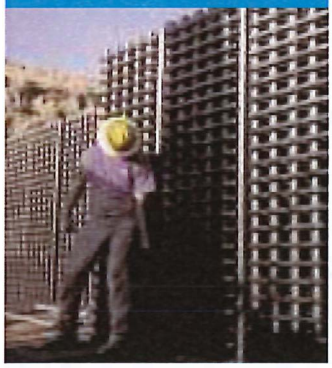
Beachrings²

Beachrings², a portable and re-usable plastic boardwalk system, provides an attractive, comfortable, and slip resistant surface for equal access to beaches. Beachrings² also works well for temporary vehicle access over mud and sand.

Draincore²

Draincore² conveyance layer is used for advanced subsurface and green-roof applications. A replacement for antiquated French drains, Draincore² can maximize drainage (58 gpm per foot width) and minimize costs.

Rainstore³



Rainstore³ is the new standard in efficient sub-surface stormwater storage. Rainstore³ is modular and stackable for versatile site design. Rainstore³ is 94% void space and can be designed for detention, retention, or water harvesting for re-use.

Slopetame²

Slopetame²—much more than an erosion control blanket or mat—a completely integrated system of rings, grid, fabric, anchors, and vegetation to control erosion on some of the toughest slopes, channels, swales and more.

Quick Reference Guide for Grasspave² and Gravelpave²

	Grasspave²	Gravelpave²
Description	Connectable ring and grid system	Connectable ring, grid, and integrated fabric
Also Included	Hydrogrow polymer—exclusively for Grasspave²	Geotextile fabric molded to grid (exclusive to Gravelpave²) and anchors
Available in Large, Flexible Rolls	Yes, various sizes—see roll chart page 14	Yes, various sizes—see roll chart page 14
Colors	Black	Black, gray, tan, terra cotta, custom colors extra
Components Needed for System	Base course, sand, labor, sod or seed (irrigation is recommended)	Base course, 1¼" (3.2cm) of 3/16" to 3/8" decorative gravel, and labor
Traffic	Low speed, intermittent to moderate use	Low speed, unlimited use
Compressive System Strength	Filled: 5,721 psi (39,273 kPa); Empty: 2,100 psi (14,470 kPa)	Filled: to 5,721 psi (39,273 kPa) Empty: 2,100 psi (14,470 kPa)
Life Span	60 years	25 years
Recommended Maximum Slope	5% fire lanes, 8% car/light truck, 15-20% golf carts, pedestrian use, and trails	5% fire lanes, 8% car/light truck, 15-20% golf carts, pedestrian use, and trails
Stormwater Storage	Yes	Yes
Clean Pollutants through Bioremediation	Excellent	Good
Air-Conditioning Effect	Yes	No
Heat Island Mitigation	Yes—thermal conductivity, heat storage capacity, density, albedo (.40) and emissivity	Yes–thermal conductivity, heat storage capacity, density, albedo (varies) and emissivity
Reduces Runoff and Non-Point Source Pollution	Yes	Yes
Recycled Content	100% recycled HDPE plastic	100% recycled HDPE plastic, remnant fabric
Erosion Control	Yes	Yes
Airborne Dust Capture and Retention	Excellent	Good
Promotes and Retains Tree Growth	Yes	Yes
Recharges Groundwater	Yes	Yes

Invisible Structures, Inc.
1600 Jackson St., Suite 310, Golden, CO 80401, USA
800-233-1510 · Fax: 800-233-1522
Overseas and locally: 303-233-8383 · Fax: 303-233-8282
www.invisiblestructures.com
email: sales@invisiblestructures.com

From: Mosher, Ana Hilda
To: Tejirian, Jeremy; Taylor, Tammy
Subject: FW: please add to Tarigo public record
Date: Wednesday, September 05, 2018 1:01:06 PM
Attachments: image001.png
image007.png
image008.png
image009.png
image010.png
image011.png

. . . . . .

ANA HILDA MOSHER
SENIOR SECRETARY/PLANNING COMMISSION SECRETARY

County of Marin
Community Development Agency
3501 Civic Center Drive, Suite 308
San Rafael, CA 94903
415 473 6278T
415 473 7880 F
415 473 2255 TTY
CRS Dial 711
amosher@marincounty.org

STAY CONNECTED:

"Please consider the environment before printing this email or attachments"

From: Christina l Desser <cdesser@me.com>
Sent: Monday, September 03, 2018 5:47 PM
To: Mosher, Ana Hilda <AMosher@marincounty.org>
Subject: please add to Tarigo public record

. . . thanks

Begin forwarded message:

From: CHRISTINA L DESSER <cdesser@me.com>
Subject: Re: the letters you prepared . . .
Date: August 31, 2018 at 7:49:01 PM PDT
To: Adrienne <aterrass@gmail.com>

Hi—I have been busy moving, hence delayed response. Thanks for what you sent. With regard to communicating with commissioners—best to work through staff and get everything in public record. Ex parte communication is allowed, but doesn't happen much in practice and I imagine most of the commissioners would prefer not.

I am still seeing if I can think of someone who could help with the state agencies.

Chris

Chris Desser
415-314-0212

Sent from my iPhone--please forgive iTypos

On Aug 29, 2018, at 9:09 PM, Adrienne <aterrass@gmail.com> wrote:

> Hello Chris,
>
> Thank you so much for the email, and I sincerely apologize for the delay in replying. Yesterday we desperately needed to recover, regroup, and deal with a serious backlog of non-County-related personal business. The sleep deficit alone will require substantial recovery time, and family life is like one long public meeting strategizing the effective negotiation of our situation.
>
> That aside, we had excellent news Monday afternoon from a consultant who had just returned from vacation. His excerpts of pertinent data are copied in an attachment here as "Cal Fire-Cafferata", the first and last paragraphs of which convey clear support for our argument for the validity of the methods used in our hydrology report. Aldo is working with him to set up the appropriate transmission of the data to the County, and we would gratefully be advised from your side as to what form such information would best take to make the pertinent data most efficiently recognizable and authoritative to County staff and officials. Naturally it is contained in rather substantial technical documents, which of course can be referenced.
>
> Which raises the question: What governs protocol between us and the

Planning Commissioners in this interim period before the October meeting? Consistent with our expectation, Aldo and I were both impressed by the thoughtfulness of the Commissioner's questions, although it was clear that there was differing importance given to various issues on an individual basis. Can we address these concerns through direct communication, and if so, to the Commission as a whole or better individually customized? We're sensitive to the demand on time the study of documents represents and wish to be respectful of each of you, as well as adhere to County rules.

I'm not exactly sure either what is or isn't posted at this point, and we are working on getting that updated, so the following may or may not already be there. Since you asked specifically about the hydrology, and some of these address other issues as well, I'll point you in the right direction within each document.

Regarding attachments:

1) **Cal Fire — Cafferata excerpt --** provides references supporting the validity of our Hydrology Report.

2) **21 Barranca Rd. List of discrepancies between Project Documents and Initial Study/Staff Report** -- the last three bullet points are the pertinent sections on hydrology from our point of view, with the third also addressing the issue of the abutments.

3) **Hydrology from Final San Geronimo Valley Existing Conditions Report,** as published in the 2009 Salmon Enhancement Plan, further supports this view, and it is of note that the included graph shows that the high-water event in 2006 exceeded that which occurred in 1982, a notorious year in many areas, including the San Lorenzo Valley in the Santa Cruz mountains where I lived at the time, as well as the Hamilton area of Novato as mentioned by Peter Theran. This event was weathered completely without incident by our bridge, and we believe it maintained freeboard of no less than 30", though we have no actual measurements to demonstrate this. Incidentally, the 'water topping the banks' account (as attributed to us as eye-witnesses) has never even remotely come to pass, and would have meant that the main corridor of San Geronimo Valley would have been inundated far beyond anything seen in recent years.

4) **Timeline of Hydrology Reports** --goes into greater detail, but redundant to data in 2) **21 Barranca Rd. List of discrepancies** above.

5) **Existing and New Lot Coverage narrative** --as in 4), redundant to 2)

above but perhaps useful.

Any suggestions you have for an appropriate attorney are more than welcome, though we do hope to minimize expenses in that regard. Since we have some help and are trying somewhat directly to obtain support of State and/or Federal agencies, one very pertinent question for an attorney is whether these agencies do indeed claim jurisdiction over structures such as abutments when within top of bank as Berenice Davidson said, which might yield more opportunity for moving forward than indicated would be possible by County staff.

Should you deem it appropriate, you may share this with the other Commissioners as you see fit and as we await further direction on protocol, which we will pursue as well through official channels.

Many thanks to you and all of the Commissioners who were sympathetic to our plight regardless of remaining reservations regarding our project and pending verification of the facts.

Sincerely,

Adrienne

Adrienne Terrass
21 Barranca Rd.
Lagunitas, CA 94938-0383
415 488-9121

On 8/27/18 8:40 PM, Christina l Desser wrote:

> Hi: can you send me the two letters that you prepared detailing the water issues? I did not keep anything from the hearing and I am not sure if they are posted.
>
> Thanks,
>
> Chris

Chris Desser
45 Knob Hill Road
Point Reyes Station, CA 94956
415-314-0212

<1) Cal Fire — Cafferata excerpt.pdf>

<2) 21 Barranca Rd. List of discrepancies between Project Documents and Initial Study:Staff Report.pdf>

<3) Hydrology section of SGV SEP Existing conditions Rept.pdf>

<4) Timeline of Hydrology Reports.pdf>

<5) Existing and New Lot Coverage narrative.pdf>

Chris Desser
45 Knob Hill Road
Point Reyes Station, CA 94956
415-314-0212

From: Mosher, Ana Hilda
To: Tejirian, Jeremy; Taylor, Tammy
Cc: Davidson, Berenice
Subject: FW: the letters you prepared . . .
Date: Wednesday, September 05, 2018 1:03:16 PM
Attachments: 1) Cal Fire — Cafferata excerpt.pdf
2) 21 Barranca Rd. List of discrepancies between Project Documents and Initial StudyStaff Report.pdf
3) Hydrology section of SGV SEP Existing conditions Rept.pdf
4) Timeline of Hydrology Reports.pdf
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image001.png
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image013.png
image014.png
image015.png
image016.png

. . . . . .

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415 473 7880 F
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amosher@marincounty.org

STAY CONNECTED:

"Please consider the environment before printing this email or attachments"

From: Christina l Desser <cdesser@me.com>
Sent: Monday, September 03, 2018 5:46 PM
To: Mosher, Ana Hilda <AMosher@marincounty.org>
Subject: Fwd: the letters you prepared . . .

Hi Ana Hilda: Can you add this correspondence to the Tarigo public record? I will send my response to add too.

Thanks,

Chris

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From: Adrienne <aterrass@gmail.com>
Subject: Re: the letters you prepared . . .
Date: August 29, 2018 at 9:09:43 PM PDT
To: Christina l Desser <cdesser@me.com>

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> 415-314-0212

Chris Desser
45 Knob Hill Road
Point Reyes Station, CA 94956
415-314-0212

Call Fire — Cafferata

Attached find the methods (Cafferata et al., 2017) that **Cal Fire recommends for estimation of the 100-year flood applied to the design of watercourse crossings**. A primary recommendation from Cal Fire is that flow transference methods (using the USGS prediction method [Gotvald, 2012, attached] and/or **extrapolation from local gauging records) yield the best prediction**.

Specifically, Cafferata et al., 2017 states that:

"In general, flow transference methods are preferred for determining 100-year flood flows in drainage basins where nearby long-term stream gaging station data are available, because local streamflow data are more likely to represent drainage-basin characteristics that determine peak flows than analytical relationships or regional regression equations." (p. 2)

On P.8 they also mention that:

"because hillslopes in the watershed contribute runoff through subsurface flow and saturation overland flow, both of which respond more slowly than Horton overland flow, methods that assume that runoff is generated primarily by Horton overland flow are likely to underestimate flow times and so overestimate peak discharges." (p. 8)

The TR-55 assumes that runoff is generated by Horton overland flow (which in forested watersheds typically only occurs within disturbed/compacted areas), and not subsurface flow and saturation overland flow (which are the flow paths that dominate runoff routing in forested watersheds).

In summary, the Cal Fire recommended approach points out why the TR-55 likely overpredicts the 100-year flood, and why the other approaches based on extrapolation from the local San Geronimo gage and/or the USGS method are expected to produce much more accurate estimates of the 100-year flood.

21 Barranca Rd.
List of discrepancies between Project Documents and Initial Study/Staff Report

- The proposal specifies TuffTrack, a pervious paving system, for the new driveway, but it is treated as impervious in the analysis, while a product with inferior specifications for permeability is recommended as a mitigation. Proposed Lot Coverage is mistakenly inflated by the inclusion of the TuffTrack area.

- The project proposes the restoration of 2300sf of semi-pervious compacted road base to ecologically functional habitat, as described in the text of the IS. However, this area is unaccounted for in the total for existing Lot Coverage, and its conversion to permeability is not shown to have lowered TIA as proposed. MCC specifies that any surface with a runoff of more than 50% be included in Lot Coverage, so it is unclear why it was not included.

- Of the above mentioned 2300sf, a surplus of 1649sf remains over and above the portion which would achieve a net zero change in TIA for all construction, consistent with the CWP. This would represent a mitigation of 14.3 to 1 to allow for 115sf to be located in the 20' creek setback, quite generous compared with ratios of mitigation as discussed for a potential standard to incorporate in an SCA ordinance. Approximately two-thirds of this area is on existing footprint, while the other one-third is on the aforementioned road base, creating no new environmental impact, as is supported by the Biological Report. Further, the southern exposure which requires this modest encroachment into the setback should be recognized as an ongoing environmentally valuable contribution to the energy performance of the building in perpetuity.

- As a result of having replaced our bridge without permits in late 2006, retroactively permitting it has been our Achilles' heel, our sword of Damocles; an existential threat to our entire restoration effort. We did so on the forceful urging of the biologist then with SPAWN (likely acting unofficially) who strongly made a case for its emergency replacement. The bridge had already partially collapsed into the creek and was continuing to fail, and we had prepared a design for its replacement prior to the warning; however, with no real sense of urgency, we hadn't begun the permit process. After a major structural support log fell into the creek, and with the impending onset of the rainy season, we were prevailed upon not to delay by applying for a permit, and we were persuaded to proceed as the environmentally responsible thing to do. Unfortunately, we did not know of the possibility of retroactively permitting work done on an emergency basis then, nor were we so informed when its unpermitted status came under suspicion by DPW in 2008. The description of being warned to cease during its construction is false; it was structurally completed in November 2006, 2 years before a DPW site visit on another matter when it aroused Dave Nicholson's suspicion. Further more, peak flow in 2006-2007 measured at the Lagunitas bridge gage, as published in the SGV Salmon Enhancement Plan Existing Conditions Report, indicates a high water event that year within 10% discharge of a 100-year event, which supports the biologist's assertion of risk of environmental harm from further failure of the bridge. At a minimum, even without complete collapse, a large quantity of fine organic debris would have washed into the creek. During construction 10-12 cubic yards of such material was carried off and composted (it now grows raspberries), with any that fell caught in a tarp and removed without entering the creek. The water remained clear throughout construction, which we can document with photographs.

- Marin County Code requires 24" of freeboard above the 100 yr event. The Initial Study references only the 2014 hydrology report, in response to which DPW asserts that the bridge does not meet this requirement based on the TR-55 method for modeling the peak water

elevation for ungaged streams. This method is an older, more conservative approach based on more generalized data intended for use when no local data is available. The updated 2017 hydrology report utilizes two more recent methods based on actual data from local and state sources, which result in a more accurate assessment of the bridge's performance. The report was prepared by CSW/ST2, licensed professionals in good standing, using gaged data to yield more realistic results consistent with local measure, yet DPW classifies these as "unusual" or "non-standard" modeling methods, apparently simply because they are not TR-55.

- One of these is the San Geronimo Report, which predicts 100-year peak runoff flows in San Geronimo creek, of which Barranca creek is tributary, and is more consistent with the Existing Conditions report as published in the San Geronimo Valley 2009 Salmon Enhancement Plan than is the TR-55, which overestimates peak flow in comparison. This method, using 26 years of actual gaged data on San Geronimo creek at Lagunitas bridge, substantiates a freeboard of 29" for our bridge. The other method, the USGS's "Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006" published in 2012, results in an even lower water surface elevation, yielding an even greater freeboard measurement.

- DPW requires a redesign of the bridge so that its supporting structure is entirely beyond top of bank and above the 100-year flow, even though this wording is not found in the code. Rather, the bridge is consistent with MCC 24.04.520 (a) & MCC 24.04.530, which provide clear direction for the design of such structures within the creek as long as it can be demonstrated that erosion will not occur, which is the case for the bridge as built. This is supported by analysis in the hydrology report as well as by the absence of evidence of erosion or scour according to the biology report. Further, the suggested replacement specifications would more than double the impervious area of the bridge, interfere with code required drainage away from the house, and create a very problematic turning radius on approach, conditions which may well interfere with other required code. It is also remarkable that the environmental impact of removing the approximately 43 ton existing bridge is nowhere considered in the current evaluation, since the bridge is considered non-existent for the purposes of the retroactive permit process. The fact that it was brought into existence illegally should not preclude a reasonable assessment, the absence of which then requires an astonishingly unnecessary adverse environmental impact to build a bridge which performs more poorly.

Table 3-6. Summary of existing conditions residential house size, parcel size, and length of creek frontage for improved lots in the San Geronimo Creek watershed SCA.

Metric	Existing Conditions	Context
Residential house size	Median house size within San GeronimoValley SCA is 1,544 ft^2 (143.4 m^2) (n=790).	Median house size for Marin County is 1,890 ft^2 (175.6 m^2) (n=61,026).
Parcel size	Median size of parcels within the SCA is 16,500 ft^2 (1,532.94 m^2) (0.38 ac [0.2 ha]) (n=775).	Montezuma Creek subbasin has smallest median parcel size (0.25 ac [0.10 ha]) and Arroyo/ El Cerrito/Barranca Complex subbasin has the largest median parcel size (2.04 ac [0.82 ha]).
Creek frontage	Average length of creek per parcel in the SCA is 159 ft (48.5 m) (n=292) for developed parcels and 209 ft (63.7 m) for undeveloped parcels (n=72).	Developed parcels in the Arroyo/ El Cerrito/Barranca Complex subbasin possess an average of 327 linear feet (100 m) of creek per parcel. Montezuma Creek parcels possess an average of 82 ft (25.0 m) of creek per parcel.

Source of data and analysis: Marin County Assessor-Recorders Office 2009.

3.4 Hydrology

The San Geronimo Creek watershed experiences a mild Mediterranean climate, dominated by dry summers and wet winters, with winter periods exhibiting periodic intense rainfall events (Fischer et al. 1996). Discharge within San Geronimo Creek is therefore characterized by long durations of low flow, punctuated by high-flow events that travel relatively quickly through the watershed. The annual maximum discharge for San Geronimo Creek, measured at the MMWD stream gage located on Lagunitas Road bridge (approximately 0.7 mi upstream of the Lagunitas Creek confluence [Figure 1-1]), ranges over an order of magnitude during the past 26 years (1980 to 2006), with the largest annual maximum flows occurring during WY ("Water Year," from October through the following September) 1982 (3,810 cfs) and WY 2005 (3,940 cfs) (Figure 3-6). Compilation of the annual maximum data for the period of record indicates that the discharge expected to be equaled or exceeded at least once in one-half of all years (*i.e.,* $Q_{2\text{-yr}}$) is approximately 1,356 cfs (Figure 3-7). Mean daily discharge data for the period of record indicate that, on average, the annual daily mean flow is less than 15 cfs and the vast majority (~99%) of the daily mean flow values are equal to or less than 750 cfs (Figure 3-8). The highest mean daily discharges for the period of record occurred during WY 1982 and WY 2006 and were greater than 1,000 cfs. Annual average daily mean flow for the'low flow' period (June through September) ranges between 0.15 cfs and 1.7 cfs over the period of record, with individual daily mean flow values during this period ranging from 0.03 cfs to 12.4 cfs (Figure 3-9).

Flood flows within the watershed are considered 'flashy,' meaning that there is a rapid increase in discharge over a short time period with a quickly developed peak discharge in relation to normal base flow (Ward 1978). One measurement of 'flashiness' is the ratio of the annual maximum instantaneous discharge to the associated daily mean discharge for the day in which the annual maximum instantaneous discharge occurred. Within San Geronimo Creek, this ratio averages 3.4 (range = 1.8 to 8.4 from WY 1982–2006), whereas ratios for other coastal watersheds of similar size can be much less. For comparison, Albion River watershed (Mendicino County, CA), a nearby coastal watershed with a similar watershed area as San Geronimo Creek but lower development density, has an average 'flashiness' ratio of 1.99. Differences in 'flashiness' between watersheds can be an expression of both natural and anthropogenic conditions, and this analysis has not discriminated between the former (*e.g.,* local storm intensity, topographic relief, geology and soil development) and the latter (watershed land use, vegetation cover, extent of impervious surfaces).

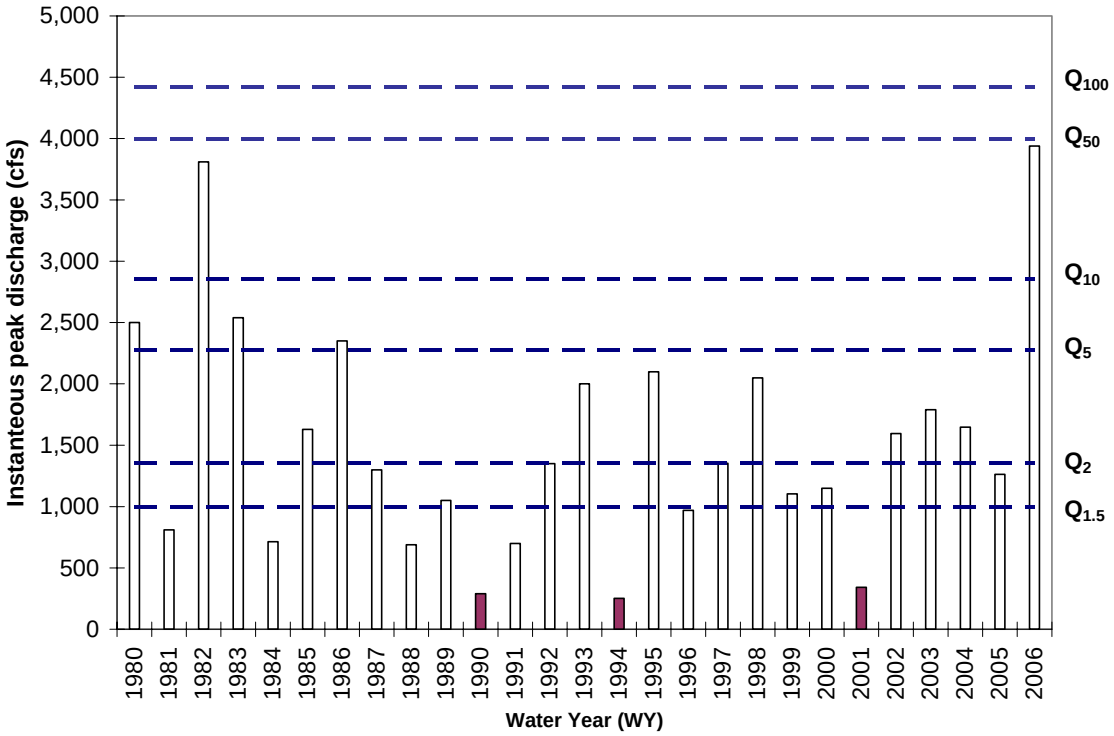

Figure 3-6. Annual peak discharges for San Geronimo Creek at the Lagunitas Road bridge.

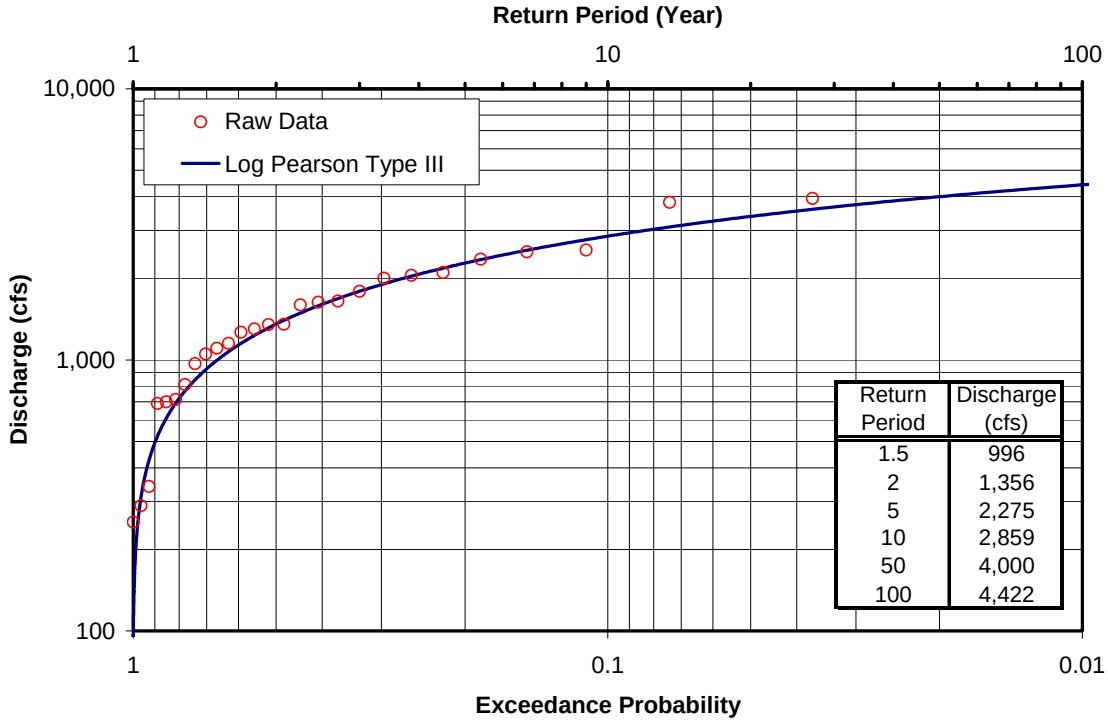

Figure 3-7. Flood frequency curve for the San Geronimo Creek at Lagunitas Road bridge (WY 1980-2006).

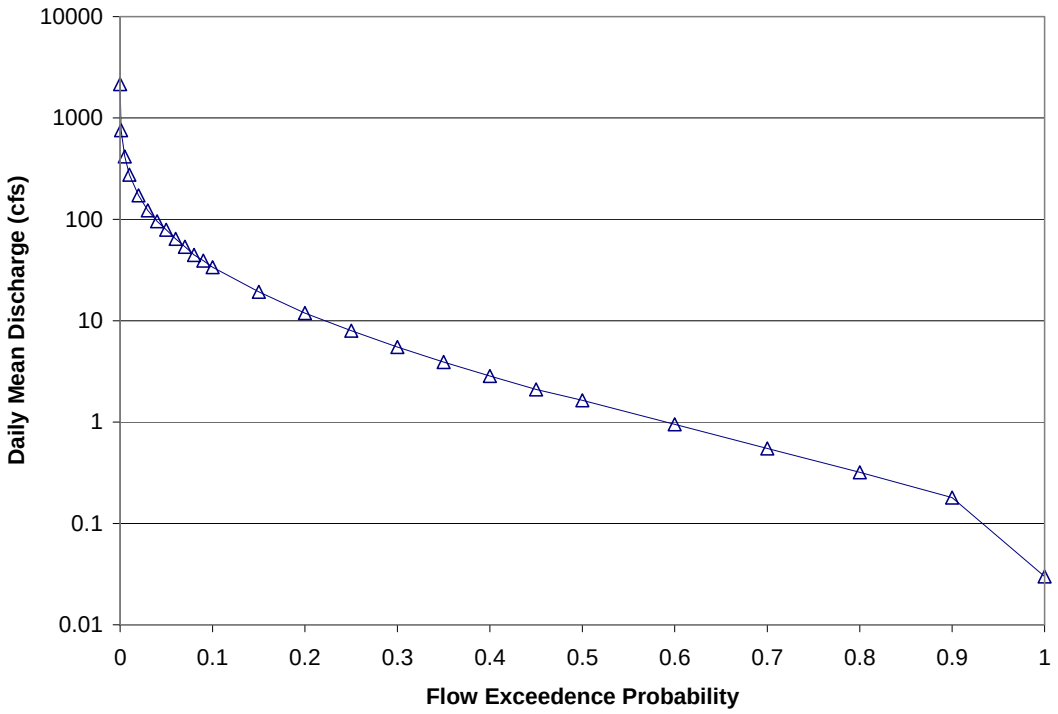

Figure 3-8. Daily mean flow duration for San Geronimo Creek at Lagunitas Road bridge (WY 1980-2006).

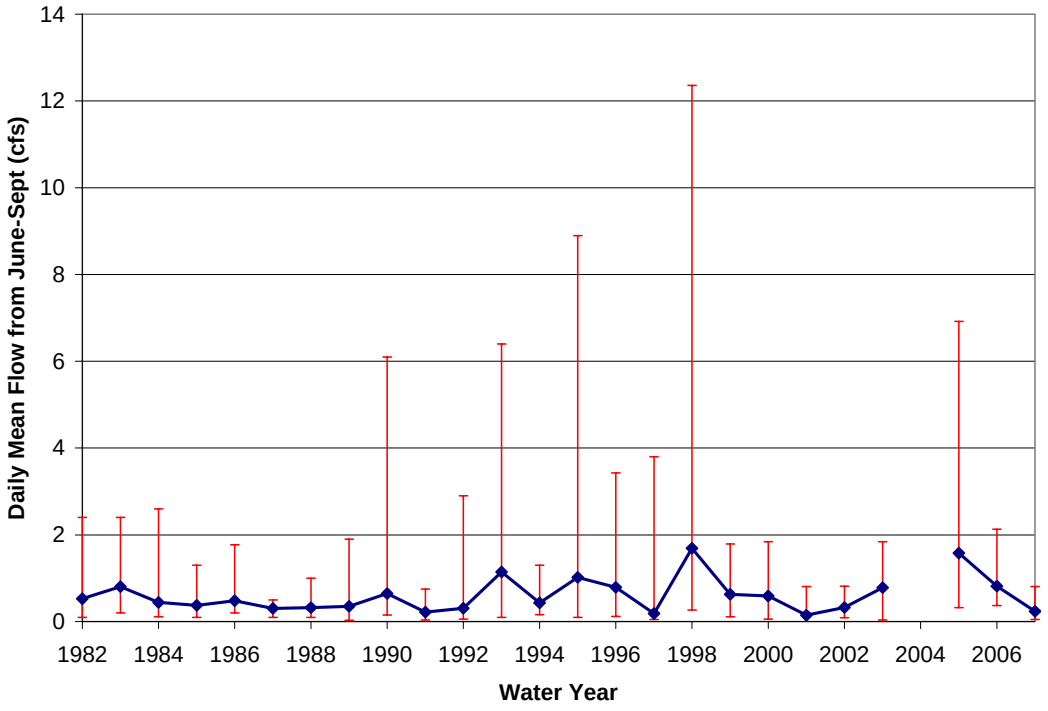

Figure 3-9. Annual average daily mean flow from June through September for San Geronimo Creek at Lagunitas Rd bridge. Bars show the annual minimum and maximum daily mean flow. Data for Water Year 2004 are unavailable.

The hydrology of San Geronimo Creek is undoubtedly affected by water diversions and groundwater pumping. The (incomplete) data indicate that approximately 75 groundwater wells are present in San Geronimo Valley, with the majority located along the mainstem San Geronimo Creek (~50%), in the Arroyo/El Cerrito/Barranca Creek subbasin (~30%), and in the Woodacre Creek subbasin (~20%) (data provided by S. Callow Marin County Department of Environmental Health Services [2008]). Most parcels that appear to possess wells are located near a stream channel and approximately 25% of these parcels are located at least partially within the SCA (*i.e.,* within 100 ft [30.5 m]) of the stream channel). While these data give some indication that groundwater wells are likely to affect creek flow and salmonid habitat, particularly during summer low-flow periods, additional information would be necessary to ascertain the hydrologic and biologic effects of groundwater pumping, including a complete inventory of well locations, known or estimated water use from each well, and existing water diversions.

3.5 Water Quality

The Lagunitas Creek watershed ultimately discharges to Tomales Bay (Figure 1-1). The San Francisco Bay Basin Plan (Basin Plan) lists existing and potential beneficial uses of water bodies throughout the San Francisco Bay Region, including Tomales Bay and Lagunitas Creek, and presents narrative and numeric water quality objectives for human consumptive, aquatic life, wildlife, and recreational uses (CRWQCB 1995). While San Geronimo Creek is not explicitly listed in the Basin Plan, as a major tributary to Lagunitas Creek and Tomales Bay it is included in consideration of potential impacts to beneficial uses for these explicitly listed water bodies. Table 3-7 lists existing beneficial uses for Tomales Bay and Lagunitas Creek (CRWQCB 1995).

Table 3-7. Existing beneficial uses for Tomales Bay and Lagunitas Creek.

Beneficial Use[1]	Tomales Bay	Lagunitas Creek
Agricultural supply (AGR)		X
Municipal and domestic supply (MUN)		X
Ocean, commercial, and sport fishing (COMM)	X	
Shellfish harvesting (SHELL)	X	
Cold freshwater habitat (COLD)		X
Fish migration (MGR)	X	X
Preservation of rare and endangered species (RARE/T&E)	X	X
Fish spawning (SPAWN)	X	X
Warm freshwater habitat (WARM)		X
Wildlife habitat (WILD)	X	X
Water contact recreation (REC-1)	X	X
Noncontact water recreation (REC-2)	X	X

Source: CRWQCB 1995
[1] Only beneficial uses that apply to either or both water bodies are shown.

In addition, the Tomales Bay Watershed Pathogens Total Maximum Daily Load (TMDL) has been developed to ensure protection of water contact recreational uses and shellfish harvesting in Tomales Bay (CRWQCB 1995). Tomales Bay and its major tributaries, including Lagunitas, Walker, and Olema creeks, are considered impaired by pathogens based on exceedances to bacteria water quality objectives. Nutrient, sediment, and mercury sources to Tomales Bay are also currently of concern to the SWRCB. Lagunitas Creek is listed along with Tomales Bay and Walker Creek as impaired by excess nutrients

Timeline of Hydrology Reports

Following is a brief history of the hydrology reports generated by CSW/Stuber-Stroeh for the purpose of analyzing the effect of water flow in the creek and the performance of the bridge over Barranca Creek

September 10, 2014

The 2014 'Hydrology and Hydraulic Analysis' by CSW/ST2, as referenced in the Initial Study, was based on the TR-55 method for determining peak flow in ungaged creeks in the U.S. where no local data is available. The project parameters included the existing extremely narrow creek channel north of the bridge formed by a concrete retaining wall on the east bank and natural rock on the west, as well as imprecise creek bed topography as shown in the 1994 property survey. Modeling showed the 100-yr flow level topping the creek bank at the large fir tree, some 64ft north of the bridge. In 25 years of living here, we've never seen evidence of water having been close to that height, including the 50-yr scale event in 2006, suggesting that the model was far too conservative.[1] The key point is that the bridge was not the cause of this modeled flooding, and rather shows that the water level drops 10" as the water moves from the narrow creek channel to the much wider bridge span.

December 7, 2016

The 2016 report was generated after the project was revised, based on DPW's recommendation, to reflect the removal of the creek wall, restoration of the bank to a 2:1 slope, and removal of the 30" high dam 32ft south of the bridge. More accurate creek sections were also included. The TR-55 model showed that the bridge now would have 28" of freeboard above the 100-yr flow.

November 30, 2017 Supplemental

After an MPC meeting and subsequent site meeting including state and federal agencies, it was determined that it would by nearly impossible to obtain the necessary permits to dredge the creek following the removal of the dam, requiring yet another report update. At the site meeting, and after some hand calculations, it was pointed out by the Water Resources Board geomorphologist, that the modeled flow exceeded the expected result by about 30%. He then suggested other modeling methods based on local gage data and up to date regional flooding measurements. CSW/ST2 then generated a final report, after a correction for missed time-of-concentration in the modeling, in November of 2017. The result showed a range of 24.5" to 30" of freeboard for the bridge. Time of concentration shows that the abutments would be in contact with the peak flow for less than 2 hrs in a 100-yr flow. High water levels predicted with this approach are more consistent with the range of observed peak flows.

This model also addressed scour in comparing 100-yr flow velocity between bridge and no-bridge conditions and shows a modest increase in velocity: a slight decrease at the abutments and an increase in the center of the channel. However, it is noted that the "exposed bedrock is anticipated to withstand these velocities without appreciable scour." Again, this increased velocity lasts for less than 2 hours. It is important to note that even with the high velocities through the bridge caused by the existing narrow channel condition upstream, there is no evidence of scour, as referenced in the Biological report. The potential for erosion will be even further reduced with the removal of the creek wall.

[1]The 2006 peak flow event is shown to be within 10% of the projected flow in a 100-yr event, according to the 'Annual peak discharges' and 'Flood frequency curve' for the San Geronimo Creek at Lagunitas Bridge in the 2009 SGV report.

Existing and New Lot Coverage – Total Impermeable Area

Existing

For some reason, the 2300 sf existing driveway at 21 Barranca Rd wasn't included in the existing total lot coverage. Marin County Code section 22.130.030 - Lot Coverage requires any impervious paving or hard surface that has a runoff coefficient of 0.5 or more to be included in the total. Considering the permeability of gravel paving, a number of municipality websites agree on a runoff coefficient range from 0.35 for loose graded gravel to 0.85 for compacted ungraded gravel or crushed rock. The existing gravel paving is clearly in the latter category, and at a minimum meets the 0.5 threshold.[1] As the Tarigo/Terrass Project Areas chart shows, the existing total of house footprint, driveways, slabs, decks and bridge is 6069 sf.

Proposed

The new house footprint, driveways, slabs, decks and bridge total impervious area is 4420 sf. The 1949 sf area of the proposed Tufftrack paving system is designed to be highly porous and well below the 0.5 runoff coefficient to count as lot coverage, and therefore should not be included in the total impermeable area.

Initial Study error

The Initial study project description makes an error in not reflecting these totals. In reading the project description, I had mistakenly transposed the reported existing and new lot coverage areas: 6169 sf proposed and 3369 existing. Usually the existing figure comes before the proposed in reading order. Although different, the totals seemed within an acceptable range, as we were removing much more lot coverage than adding, and I did not realize they were in fact reversed. I regret this oversight; however, the underlying fact remains that the IS discounted the existing impermeable gravel driveway without explanation and misreads the product specification for the Tufftrack paving system.

Mitigation

The portion of Mitigation Measure 1.B.1 that discusses the footprint of the proposed Studio, therefore, is based on the erroneous conclusion that the proposed project would increase lot coverage substantially, thereby violating CWP standards. Since there is actually to be a reduction, it would seem this error could easily be corrected. We would be happy to accept the part of 1.B.1 that discusses the new driveway and will submit to the County for review a paving specification that does not add to TIA, as requested.

[1]The fact that rain water runs off readily or pools in some spots for many hours, and that plant roots cannot penetrate to sustain life supports this conclusion.

From:	Aldo Tarigo
To:	Taylor, Tammy
Cc:	Adrienne Terrass; Tejirian, Jeremy
Subject:	Re: 21 Barranca lot coverage
Date:	Tuesday, September 25, 2018 6:00:52 PM
Attachments:	image002.jpg image002.jpg

Hi Tammy,
The the basis for the tabulation sheet and the graphical areas dated August 31 were based on the Title 22.130 code definition. I tried to find the referenced BASWMAA guidelines, but they are not available on their website. The only difference between this updated tabulation and the earlier version was the addition of the existing and new raised decks, per definition. A word on the existing driveway: The paving is composed of compacted gravel and crushed rock, which has a rated runoff factor of between 0.7 and 0.85, so anything above 0.5 has been included. 2300 sf of this driveway is visible and so verifiable. An additional 800 sf (or more) is now under soil and is not included in the total. (Although a driven spike encounters stiff resistance at 4", and so doesn't perc very well.) When we moved in in 1994, there were three living units and parking space for 8 vehicles, thus the 3000+ sf total. Overall, the area square footage numbers are generated from the AutoCAD computer model by clicking on the individual graphical areas as shown. I hope this answer your questions.
Aldo

On Tue, Sep 25, 2018 at 12:54 PM Taylor, Tammy <TTaylor@marincounty.org> wrote:

> Hi Aldo,
>
> I would like to ask for clarified information about lot coverage calculations for your project. Specifically, I need to have the lot coverage calculations based on the definition in our Development Code Title 22.130 Definitions. The definition of lot coverage states as follows:
>
> - Lot Coverage. Lot coverage is the percentage of total site area occupied by buildings and other structures, impervious paving and other hard surfaces that have a water runoff factor of 0.5 or more according to the Bay Area Storm Water Management Agencies Association guidelines. Structure/building coverage includes the primary structure, all accessory structures (e.g., carports, garages, patio covers, storage sheds, trash dumpster enclosures, etc.) and architectural features (e.g., chimneys, balconies, decks, porches, stairs, etc.). Structure/building coverage is measured from exterior wall to exterior wall. See Figure 8-4 (Lot Coverage).
>
> FIGURE 8-4
> **LOT COVERAGE**

22.130.030.8-4.png

Can you please send me this information and verify that it is based on the definition that is codified in Title 22 the Development Code (as noted above)? I will add this information in to the Initial Study before I send it back to you for review.

Thank you,

Tammy Taylor
PLANNER

County of Marin

Community Development Agency

3501 Civic Center Drive, Suite 308

San Rafael, CA 94903
415 473 7873 T
415 473 7880 F
CRS Dial 711

ttaylor@marincounty.org

From: Aldo Tarigo <aldo.arch@gmail.com>
Sent: Friday, August 31, 2018 6:01 PM
To: Taylor, Tammy <TTaylor@marincounty.org>
Cc: Adrienne Terrass <aterrass@gmail.com>; Tejirian, Jeremy <JTejirian@marincounty.org>
Subject: 21 Barranca lot coverage

Hi Tammy,

Attached is an updated tabulation of all of the project area parameters, including most importantly lot coverage. The attached graphics show the basis for the computer generated area calculations in existing and proposed conditions. I'll drop off two printed copies of these documents, as well as additional documents to come, on Tuesday.

Aldo

From: Cordova, Lorenzo
To: Taylor, Tammy; Tejirian, Jeremy
Subject: FW: 21 Barranca Rd
Date: Thursday, September 27, 2018 12:54:55 PM
Attachments: image001.jpg

Sharing this email to both of you. FYI Dennis will not going to "represent" them in any dispute matters—he's not a lawyer nor is it appropriate since this has not reached the BOS. He's well aware of the process and is turning to you for any resolution, if any. Will or have you responded to his letter? Feel free to send me a copy or cc me when you do. Thanks for all your help on this.

Lorenzo

Lorenzo Cordova |Office of Supervisor Dennis Rodoni
T: (415) 473-3092
E: lcordova@marincounty.org
3051 Civic Center Drive, Suite 326
San Rafael CA, 94903

From: Aldo Tarigo <aldo.arch@gmail.com>
Sent: Tuesday, September 25, 2018 12:02 PM
To: Cordova, Lorenzo <LCordova@marincounty.org>
Cc: Adrienne Terrass <aterrass@gmail.com>
Subject: 21 Barranca Rd

Hi Lorenzo,
I'd like to have an off-the-record chat with you regarding any response to our recent letter, and also to seek your advice on how supervisor Rodoni might represent us in a potential dispute with the County and to help resolve this dispute before it becomes a legal matter. I've spoken with Planning and reassured them that we are not attempting to delay the October 22 Planning Commission hearing and would seek to resolve any outstanding issues before the new CWP becomes law. Please call me as soon as you can. 415.816.2337.
Thank you,
Aldo

From: Aldo Tarigo
To: Taylor, Tammy
Subject: Re: Revised Project Description
Date: Monday, October 01, 2018 10:09:14 AM
Attachments: Tarigo Project Description_edit_2018.10.01.docx

Hi Tammy,
Hope your Monday is going well. Attached is the Project Description with my suggested edits: red is for deletion and blue is for inclusion. Do you have an estimate of when the revised draft IS will be released?
Thanks,
Aldo

On Thu, Sep 27, 2018 at 6:06 PM Taylor, Tammy <TTaylor@marincounty.org> wrote:

> Hi Aldo,
>
> I have revised the project description for the Tarigo project that is included in the Initial Study. I have attached the track-changed project description to this email for your reference. Please note that I took the calculation of the previous wooden bridge into account, which lowered the pre-existing lot coverage estimate by approximately 3 feet. Other than that, the numbers that you sent us have been reflected in the track-changed project description. If you still dispute the calculations included in the attached project description, please explain why and send me additional information in support of your assertion.
>
> Thank you,
>
> **Tammy Taylor**
> PLANNER
>
> County of Marin
>
> Community Development Agency
>
> 3501 Civic Center Drive, Suite 308
>
> San Rafael, CA 94903
> 415 473 7873 T
> 415 473 7880 F
> CRS Dial 711
>
> ttaylor@marincounty.org
>
>

Description of Project:

The applicant proposes to demolish an existing two-story 2,698-square foot residence and 442-square foot attached, legal non-conforming structure (used as an unpermitted second unit), and construct a new 2,792-square foot residence, 552-square foot attached garage, and 552-square foot attached second unit. The portion of the existing structure used as a second unit was built in 1917 and is located 15.5 feet from the creek. The proposed residence would be located in a similar location as the structure to be demolished, with the new residence 14 feet 3 inches from the new top of creek bank discussed below. The proposed three-story residence would have a maximum height of 29 feet 11 inches, result in a 6.3% floor area ratio, and have the following minimum setbacks: 27 feet 9 inches from the easterly front property line, 118 feet from the northerly side property line, 100 feet 3 inches to the southerly side property line, and 118 feet from the westerly rear property line. The exterior walls would be medium brown stucco with beige painted wood facia and dark brown glazed doors and windows. The roof would be medium brown asphalt shingles. A roof mounted photovoltaic system would also be installed onto the roof of the residence.

The existing leach pit and septic tank located approximately 16 feet from the top of the creek bank would be removed and a new class II septic system would be installed approximately 60 feet from the top of bank and 19 feet from the front property line.

In 2006, a pre-existing wooden bridge was demolished, and a new bridge was constructed to provide access for a drill rig for the installation of a well on the west side of the creek. The pre-existing wooden bridge across Barranca Creek links the east and west sides of the project site. The pre-existing wooden bridge was 12.7 feet wide, 16.8 feet long, and 2.8 to 3.9 feet above the bottom of the creek. This bridge was demolished without permits for the illegal construction of the new bridge in 2006.

The proposed project includes the legalization of a new, unpermitted, reinforced concrete bridge across Barranca Creek, that was constructed illegally without permits in 2006 to replace the previously discussed pre-existing wooden bridge. The bridge constructed in 2006 is located approximately 86 feet from the east front property line, 115 feet from the south side property line, and 80 feet from the rear property line. The bridge arches with a 5-foot 1-inch height above the creek bed at its apex. The 12-foot wide bridge spans approximately 18 feet across the creek and is faced with hand set field stone. The bottom of the creek is 8.5 feet wide at the bridge crossing. The concrete abutments are 12 feet apart and generally located in within inches of the same location as the abutments for the pre-existing wooden bridge.

The proposed project would also include bank restoration. The existing concrete and stone retaining wall along the eastern portion of the creek bank would be removed for the creation of a 2:1 slope bank for up to 40 feet. The bank would be revegetated for long-term stability. Species used in the revegetation would be native species that occur in the area. Herbaceous species that provide cover could include the sedges (Carex sp.) that naturally occur on the project site, Santa Barbara sedge (C. barbarae) that grows in Marin County, meadow barley (Hordeum brachyantherum), California brome (Bromus carinatus), and the ferns (chain, lady, polypody, and sword) that naturally occur on the project site. Suitable shrubs for the bank planting include snowberry (Symphoricarpos albus and/or S. mollis), California rose (Rosa californica), oceanspray (Holodiscus discolor), and flowering current (Ribes sanguineum). Removal of the retaining wall would

occur during the dry season, June 15 through October 15. Bank restoration would require the removal of a 40-inch California bay (Umbellularia californica) tree and the bank would be replanted with native plants species. For the restoration in this area, heavy construction equipment would operate from the top of the bank and would not enter the bed of the creek. Plywood sheets (e.g., 4 x 8 feet), covered in heavy plastic sheeting, would be set at the creek-side base of the wall lying over the creek bed to prevent debris from entering the creek bed. At that point, the wall will be pulled down on the new bank and removed. After the demolition and removal of the wall, the plywood and plastic sheeting would be removed from the creek bed. Biodegradable mesh would then be laid and pinned on the bank over new top soil and the new plantings added. Additionally, the proposed project includes the removal of two 20-inch diameter apple trees that have exceeded their lifespan. A bio retention garden to filter roof runoff would be located along the existing driveway entrance.

The proposed project includes the following site improvements: 1) Removal of approximately 2,300 square feet of existing 10-inch deep, semi-pervious compact road base that runs from the bridge to the existing driveway and parking area. This area will be replaced with new soil and planted with native grasses and clovers. 2) Construction of a partially pervious, one-car parking area at the existing entrance to Barranca Road and a new, second driveway from Barranca Road. Except for existing asphalt cement at the entrance, the new driveway and parking areas would be a combination TuffTrak and crushed rock. 3) Installation of a new propane tank located six feet from the front property line. 4) Construction of a new entry gate located approximately two feet from the front property line. The proposed project would reduce the pre-existing lot coverage of 6,118 square feet (which includes the pre-existing bridge) by 1,698 square feet, resulting in a proposed lot coverage of 4,420 square feet.

The proposed project is located on a 1.6-acre lot at 21 Barranca Road, approximately 0.8 mile north of Sir Francis Drake Boulevard and is in the community of Lagunitas within the unincorporated area of San Geronimo Valley in Marin County. Design Review is required because the project is located in a Planned Zoning District. A Second Unit Permit is required for a portion of the structure that would be utilized as a second unit. A tree removal permit is required for the removal of the 40-inch heritage California bay.

The project site is currently served by the Marin Municipal Water District (MMWD). There is an existing, non-potable irrigation well on the project site that would remain. The project includes a new rain water line. As proposed, the potable MMWD water lines, non-potable well water lines, and rain water lines would be separated. Overhead utility lines for power, cable, and telephone are located east of Barranca Road and are proposed to remain unchanged.