

November 10, 2022

Jean M. Bubon, AICP
Town Planner

Rebecca Gendreau
Conservation Agent

Town of Sturbridge
301 Main Street, 1st Floor
Sturbridge, MA 01566

**RE: Peer Review Response Letter
Town Staff Comments 4/14/22 and Pare Corporation Comments 5/23/22
55+ Manufactured Housing Community – Justin Stelmok
Blueberry Hill Estates - Lot 3 Berry Farms Road, Sturbridge, MA**

Dear Planning Board and Conservation Members:

McClure Engineering, Inc. (McClure) is in receipt of the following Town Staff comments date 4/14/22 and comments from Pare Corporation (Pare) date May 23, 2022, relating to “Blueberry Hill Estates” – Lot 3 Berry Farms Road, Sturbridge, MA. We are providing the following technical responses to each comment:

Staff Comments:

Fire Inspector:

1. Per 527 CMR 18.1.1.4 Fire apparatus access road plans must include an analysis and evaluation of fire apparatus maneuvers throughout the access roads created by swept path analysis and turn simulation software.
I would like to see this analysis.

McClure Response: A Fire Truck Turn Path Analysis has been added to the plan set, sheet 31.

2. Per 527 CNR 18.2.3.4.1.1 Fire Department access roads shall have an unobstructed width of not less than 20 ft.

McClure Response: All internal roadways are proposed to be 20’ wide. The emergency access to Southbridge has been revised from 12’ wide to 20 wide’.

3. Per 527 CMR 18.2.3.4.2 Fire department access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with an all-weather driving surface.

McClure Response: All internal roadways will be paved with bituminous concrete. The emergency access way to Southbridge is proposed to be constructed out of a permeable reinforced gravel and grassed paver system. The paver system shall be capable of handling loads in excess of H20 requirements. Specifications of one possible manufacturer of this paver system are attached. This system will allow for a large decrease in stormwater runoff while also providing strength and stability of the ground suitable for emergency vehicle use. This system will be mowed/maintained by the developer to ensure 24/7 passage for emergency vehicles. This system can also be plowed in the winter without damage to the ground surface. Many of these systems are designed and manufactured specifically for emergency access roads and fire lanes.

4. Per CMR 18.2.3.4.3.1 The Minimum inside turning radius of a fire department access road shall be 25ft.

McClure Response: All intersections of the proposed internal roadways have been revised to have a minimum radius of 30'. All other access road inside turning radii are greater than 25'.

I would also like to confirm that this project intends to place hydrants. I noted 2 hydrants on the plans. I would like to know the anticipated GPM for the hydrants.

McClure Response: There are a total of 10 hydrants proposed for the site. The site will require a water booster station to maintain proper flows and pressures for the development due to site topography and existing water pressure. This water booster station design includes a pump specifically for extreme fire flows and all hydrants on site will be capable of meeting the subdivision regulations requirement of 750 GPM at 20 PSI.

Conservation Agent

The project is subject to the MA Wetland Protection Act (WPA) and the Sturbridge Wetland Bylaw (SWB) and the Sturbridge Zoning Bylaw (300-4.1(E) (SZB) . A joint NOI application has been filed and a public hearing has been scheduled for 4-21-22. A joint peer review will be undertaken for stormwater management compliance for the Conservation Commission and the Planning Board. Work is proposed within the WPA 100 foot buffer zone, the SWB 200 foot buffer zone, the SZB 500 foot buffer zone. Work is also proposed within Vernal Pool Habitat, a protected resource under the SWB.

McClure Response: Acknowledged.

Concern for rain gardens how they will function in the winter.

McClure Response: Lack of widespread adoption of low-impact development (LID) designs in northern climates is in large part due to concerns about poor winter performance, which are not true. There are multiple research article and publications available which describe and prove the effectiveness of rain gardens, bioretention, and other low-impact design BMPs during winter months.

Excerpt of the Abstract from a 2009 study by the University of UNH “Seasonal Performance Variations for Storm-Water Management Systems in Cold Climate Conditions”: “LID designs are consistently top storm water management performers. Seasonal performance evaluations indicate that LID filtration designs differ minimally from summer to winter, while systems dependent largely on particle settling time (detention basins, catch basins, particle separators, swales, etc.) demonstrated a marked winter performance decline.”

Conclusion from the 2009 study by the University of UNH “Seasonal Performance Variations for Storm-Water Management Systems in Cold Climate Conditions”: “Performance evaluations indicate that LID designs have a high level of functionality during winter months and that frozen filter media do not reduce performance. In contrast, the hydrodynamic separators and the swales exhibit large variations in seasonal performance. Conceivably this might lead to the need to oversize such systems in order to meet minimum performance expectations under worse case scenarios in which reduced settling velocity must be accounted for. The need for independent field testing of proprietary devices is underscored based on the differences observed between field testing particularly during winter and performance results commonly

reported under laboratory settings. These results support the use of LID systems in cold climates and should dispel the concerns of reduced winter performance for fear of filter media freezing. It is interesting to note that many of the systems used routinely, without concern for reduced winter performance, are showing otherwise.”

See attached Rain Garden Overview document, previously provided to the Commission which includes information on two other studies done in Minnesota and Norway.

Demonstrate that the rain gardens can support the development and meet standards.

McClure Response: Raingardens as proposed are sized as to provide peak flow attenuation, as well as the necessary water quality treatment volumes, and necessary groundwater recharge. As some rain gardens are located in cut slopes will not provide infiltration but will discharge to larger downstream raingardens which do provide groundwater recharge. See attached Stormwater Management Report (analysis on MassDEP Stormwater Standards), HydroCAD Calculations, and Rain Garden Overview Document. The use of small decentralized rain gardens and bioretention versus large detention basins will help maintain existing drainage patterns, maintain similar peak flows, and volume of runoff, as well as provide better treatment than typical catch basin/ detention basin stormwater systems.

Concern over rain gardens which do not provide infiltration which discharge is directed towards vernal pools.

McClure Response: The original design included (4) raingardens which were not designed to provide infiltration, just treatment and attenuation of peak flows. One of these rain gardens was eliminated with the elimination of Lot 5. The other (3) raingardens remain. These rain gardens, due to being located in a cut slope, will be lined and therefore will not provide groundwater recharge. Stormwater directed to these rain gardens will pass through the soil media for treatment and peak flow attenuation. These rain gardens will then discharge to a pipe network which will convey this treated water to Rain Garden 5.1, a larger rain garden designed to provide infiltration. Direct discharge to vernal pools from rain gardens which do not provide infiltration has been eliminated.

Standard 4 may not be met if stormwater is able to bypass the full depth of the rain garden. Demonstrate how Standard 4 is met and provide info on what storm events will bypass the treatment.

McClure Response: The proposed rain gardens as designed are sized beyond just the water quality volume typically used for their design purposes. The rain gardens are designed to not only treat water and provide recharge but also attenuate peak flows. Local regulations and the critical areas on site require a 1” water quality depth, meaning the volume of runoff from a storm which produces 1” of runoff depth to a structure must be treated. Water quality storm events for this site varies by structure and subcatchment but is typically around 2” over 24 hours. Rain gardens are proposed with outlet control devices which include orifices above full soil depth, however these are for control of larger storm flows. No water quality flows bypass any rain garden full depth therefore meeting the requirements of Standard 4 and providing adequate water quality treatment. See the revised Stormwater Management Report Section 3.D., for more info related to the water quality storm events.

Concern over salt use and change in salinity in the vernal pools.

McClure Response: The applicant is proposing a reduced salt area along the roadways in close vicinity to the vernal pools. Alternatives to salt were explored, but many are unavailable due to shortages and

the few that were available proved to be cost prohibitive as well as having the potential to negatively affect vernal pools in other manners (higher concentrations of nitrogen or phosphorous which could cause algae issues). The reduced salt area, the reduced impervious surface of the roadway (20' wide roads), and the roadways being designed away from the vernal pools to the greatest extent possible will ensure no negative impacts to the vernal pools. A number of salt tolerant plants are proposed for the raingardens as well to ensure rain gardens remain healthy and effective.

Plans should indicate snow storage areas.

McClure Response: Snow storage areas have been added to the proposed development plans. Snow will be plowed, blown, or shoveled along the roadway and sidewalk. Snow will not be directed stored in rain gardens, however snow melt off will be conveyed to the rain gardens for treatment. In the event that snow storage along the road becomes an issue, snow will be relocated behind the clubhouse, and melt off will be directed to the proposed infiltration basin for treatment. The O&M Plan has been revised.

Demonstrate that vernal pools will not be affected by stormwater runoff.

McClure Response: The stormwater management system as designed meets and exceeds all MassDEP Stormwater Standards as indicated in the Stormwater Management Report, and as agreed on by Pare Corp, the stormwater peer engineer. No untreated discharges will be directed towards vernal pools and water which is discharged towards vernal pools will be treated well beyond the required levels of DEP (which are more stringent than normal as vernal pools are considered critical areas). Drainage patterns, peak flow rates, as well as volume of runoff to these vernal pools are being maintained to the maximum extent possible by the use of small decentralized systems with multiple discharge points rather than large detention basins with single point discharges. Peak flows by rule must be reduced (MassDEP Stormwater Standard 1), however total runoff volume is being maintained ensuring that these vernal pools will get adequate water and not become dry. See LEC Environmental's supplemental NOI narrative for additional info as the project in relation to resource areas and vernal pool habitat.

DEP Comments:

Sedimentation basins should not be located within areas where infiltration structures are proposed.

McClure Response: Plans have been revised to move sediment basins away from areas where future infiltration is proposed.

Soil testing confirming the depth to seasonal high groundwater and bedrock should be provided in all areas where infiltration is proposed.

McClure Response: Plans have been revised to indicate soil testing locations and results.

Rain gardens are not typically used to control peak runoff (standard 2) and may not meet Standard 4 if stormwater is able to bypass the full depth of the rain garden via orifices in the outlet structure.

McClure Response: McClure Response: The proposed rain gardens as designed are sized beyond just the water quality volume typically used for their design purposes. The rain gardens are designed to not only treat water and provide recharge but also attenuate peak flows. Local regulations and the critical areas on site require a 1" water quality depth, meaning the volume of runoff from a storm which produces 1" of runoff depth to a structure must be treated. Water quality storm events for this site

varies by structure and subcatchment but is typically around 2” over 24 hours. Rain gardens are proposed with outlet control devices which include orifices above full soil depth, however these are for control of peak flows from larger storm flows. No water quality volumes or flows bypass any rain garden full depth therefore meeting the requirements of Standard 4 and providing adequate water quality treatment. See the revised Stormwater Management Report Section 3.D., for more info related to the water quality storm events.

Proposed 1’-2’ ponding depths within the rain gardens may make it difficult to sustain vegetation within these areas.

McClure Response: The ponding depths vary by rain garden, however the rain gardens typically only have ponding during larger storm events. The deepest ponding of any rain garden is 18” (RG 2.1) which is during a 100 year storm event. During the water quality storm event, the two year storm event, the same rain garden does not even fill up above the top of stone layer. A ten year storm event and twenty-five year storm event result in 7” and 12” ponding depths respectively. All basins have a ponding depth of less than 12” during the WQ, two year, ten year, and twenty-five year storm events.

Pare Comments:

PLANS

1. Sheet C-1- Title Sheet- Fix spelling of “Manufactured”.

McClure Response: Revised.

2. Sheet C-1- Title Sheet – Owner is referenced as both Justin Stelmok and Fisk Hill Realty Trust. Please clarify.

McClure Response: Sheet has been revised to indicate the owner as Fiske Hill Realty Trust, and the Applicant as Justin Stelmok.

3. Sheet C-1- Title Sheet – Please modify Drawing Index to match plan sheets:
 - C-15 thru C-18: “Phasing and Erosion Control Plans” should be “Erosion and Sediment Control Plans”.
 - Add Sheet C-19 “Phasing Plan”.
 - Plan & Profile Sheets should be sheets C-20 thru C-23.
 - “Construction Details” should be “Site Details”. Should also be labelled sheets C-24 thru C-30.

McClure Response: Revised.

4. Sheet C-3 thru Sheet C-5 Existing Conditions – Show test pit locations on plans.

McClure Response: Revised.

5. Sheet C-7 Layout and Materials Plan – Cul-de-sac for Proposed Drive C exceeds 500 feet.

McClure Response: Per the Town of Sturbridge “Manufactured Housing Communities” Bylaws, the roadway grades, street profiles, and cross-section details of all roads in the development shall be designed in accordance with the Town of Sturbridge Subdivision Regulations. It is the Applicant’s belief that this does not indicate interior roadway lengths need to conform to these regulations. If road length must meet these regulations, the Applicant respectfully requests a waiver from the regulation. McClure respectfully defers to the Town Planner and Planning Board.

6. Sheet C-7 Layout and Materials Plan- Label width of Proposed Drive A.

McClure Response: Revised.

7. Sheet C-7 and C-8: Layout and Materials Plan- Is Drive A considered a major road? If so is radii of 150' acceptable?

McClure Response: Per the Town of Sturbridge “Manufactured Housing Communities” Bylaws, all turns shall not be less than 50’ measured at the center line of the roadway. The regulations also state that the roadway grades, street profiles, and cross-section details of all roads in the development shall be designed in accordance with the Town of Sturbridge Subdivision Regulations. The regulations do not state that the internal roadways need to meet minimum horizontal center-line/ alignment radius of major streets. If roadways must meet the requirements of major streets per the Town of Sturbridge Subdivision Regulations, the Applicant respectfully requests a waiver from the regulation. McClure respectfully defers to the Town Planner and Planning Board.

8. Sheet C- 7 thru C-9: Layout and Materials Plan – Curb radii shown as 20 feet. Minimum radius should be 30 feet.

McClure Response: Revised.

9. Sheet C-7 thru C-10: Layout and Materials Plan - Lot lines with areas, frontage and depth dimensions should be provided.

McClure Response: Revised.

10. Sheets C-7 thru C-10: Show bound locations on plan and provide a detail.

McClure Response: As the project is not a subdivision road, it is the Applicant’s belief that bounds are not required. McClure respectfully defers to the Town Planner and Planning Board.

11. Sheet C-8: Layout and Materials Plan- Label width of Drive A.

McClure Response: Revised.

12. Sheet C-8: Layout and Materials Plan – Label square footage of clubhouse. Should be 1,500 square foot minimum.

McClure Response: Revised.

13. Sheet C-9: Layout and Materials Plan – Label Drive A. Provide width.

McClure Response: Revised.

14. Sheets C-11 thru C-14: Grading and Drainage Plans- In general, the design concept for the stormwater layout is acceptable. Confirmation of many of the grades and elevations were difficult to review due to clarity of numbers.

McClure Response: The plans have been revised for clarity.

15. Sheet C-19 Phasing Plan – Please clarify the limits of some of the phasing. There is a Phase 1 identified in the area of the intersection of Drive A and Drive C. A separate colored Phasing Plan was provided. Please clarify which is correct. If necessary modify the plan set.

McClure Response: Phase 1 is proposed to be separated into Phases 1a and 1b, each with a temporary emergency vehicle turnaround cul-de-sac. Phase 1 limits of disturbance and rough site work will extend up Road A to the intersection of Road C as some fill from Lots 30 and 31 cuts will be needed for Phase 1. Phase 2 includes Road D, the clubhouse, and the emergency access from Southbridge. Phase 3 will be separated into Phases 3a and 3b. Phase 3a will incorporate Lots 26-29 on Road A adjacent to the emergency access, and Phase 3b involves the construction of Road B. Phase 4 incorporates the remainder of Road C. The Phasing plan has been revised to include hatching of the Phased areas for more clarity.

16. Sheet C-20: Plan and Profile Drive A: the 2% grade at the intersection with Berry Farm Road should be extended to at least 100 feet.

McClure Response: The Applicant requests a waiver for the leveling area as required under the subdivision regulations as the roadway proposed is a private driveway and not a public road. A 20' leveling area of 3% is proposed at the intersection with Berry Farms Road adequate for a vehicle to stop and make an exit maneuver.

17. Sheet C-21: Plan & Profile Drive A- due to length of cul-de-sac and waterline dead end does waterline need to be looped. Review with the water department.

McClure Response: The design was reviewed by the Water Department and DPW and no issues were brought to our attention in relation to the dead end water line.

18. Sheets C-20 thru C-23: Plan & Profiles- Label centerline elevations on profiles.

McClure Response: Revised.

19. Sheet C-24: Site Details – Bituminous Concrete Sidewalk & Driveway Detail – Gravel base shall be 8". Also, bituminous concrete sidewalks shall consist of three (3) inches of bituminous concrete applied in a base two-inch layer and a top one-inch layer. Per regulations for sidewalks, "In all areas all materials shall be removed or filled to a depth of thirteen (13) inches below the finished design grade. In areas of high groundwater, as determined by soil borings, all materials shall be removed or filled to a depth of seventeen (17) inches below the finished design grade." Add to detail.

McClure Response: Revised.

20. Sheet C-24: A vegetated area of at least four (4) feet in width shall be located between the sidewalk and the curbing, maintained in grass or retained natural vegetation, unless the Board approves an alternate sidewalk placement.

McClure Response: The Applicant is requesting a waiver to the 4' wide grass strip between the roadway and sidewalk due to site constraints and stormwater design.

21. Sheet C-27: Site Details – Typical Hydrant with Gate Detail Elevation View – 18" minimum should be 24" minimum.

McClure Response: Revised.

22. Sheet C-28: Site Details – Site Entrance Mat – Width of mat should be 24' minimum instead of 20' minimum.

McClure Response: Revised.

23. Sheet C-28: Site Details - A landscaping plan prepared by a certified landscape architect should be provided.

McClure Response: The Applicant is requesting a waiver that a landscape plan prepared by a landscape architect is required. The proposed plans include street trees along with numerous rain gardens which will provide adequate site landscaping.

24. Sheet C30: Site Details – Sidewalk Culvert Section – Sidewalk should be 3" bituminous and 8" gravel borrow.

McClure Response: Revised.

25. Sheet C30: Site Details – Rain Garden Typical Cross Section – Finish grade of rain garden is proposed to be mulch. Has stone been considered.

McClure Response: After research and discussions held with rain garden experts from the University of New Hampshire Stormwater Center, the proposed rain gardens will have a river rock surface rather than mulch as mulch has a tendency to float, and sometimes mulch can cause an increase of phosphorus in runoff. The rain garden details have been revised.

26. Site Details – Provide light detail.

McClure Response: The style and manufacturer of street lights have not been determined by the Applicant at this time. Street light details will vary depending on the make and model of light and pole.

27. General – O & M Plan - How will snow removal/storage occur?

McClure Response: Snow storage areas have been added to the proposed development plans. Snow will be plowed, blown, or shoveled along the roadway and sidewalk. Snow will not be directed stored in rain gardens, however snow melt off will be conveyed to the rain gardens for treatment. In the event that snow storage along the road becomes an issue, snow will be relocated behind the clubhouse, and melt off will be directed to the proposed infiltration basin for treatment. The O&M Plan has been revised.

Oxbow Comments:

In review of the Site Plans, OA noted some inaccuracies within the planting specimen species' list that should be remedied prior to the issuance of an Order of Conditions. The Site Plans reference a number of planting species that are non-native or invasive to Massachusetts. We have recommended similar species to the proposed that can be substituted.

McClure Response: Although the street tree species proposed were taken from the Town of Sturbridge Subdivision Regulations and the rain garden species proposed were taken from the MassDEP Stormwater Handbook, the plans have been revised and the species as noted have been substituted for those recommended.

OA also recommends consideration to use the seed mix from New England Wetland Plants, Inc. specifically designed for detention/infiltration basins within the basins, as opposed to the Conservation/Wildlife mix currently proposed, produced by the same company.

McClure Response: The plans have been revised to specify the recommended seed mix.

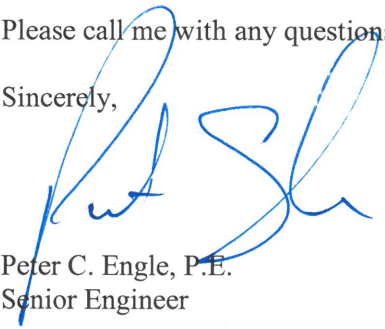
OA recommends the SCC suggest incorporating an invasive species monitoring and treatment plan into the Operations and Maintenance Plan for the rain gardens, detention basins, and any other common areas.

McClure Response: The Stormwater O&M plan has been revised to incorporate an invasive species monitoring and treatment plan for the rain gardens, infiltration basin, landscape areas, and common areas.

A copy of the revised “Blueberry Hill Estates” Lot 3 Berry Farms Road, Sturbridge, MA revise date 11/7/22, is enclosed for your review.

Please call me with any questions or comments at (508) 248-2005.

Sincerely,

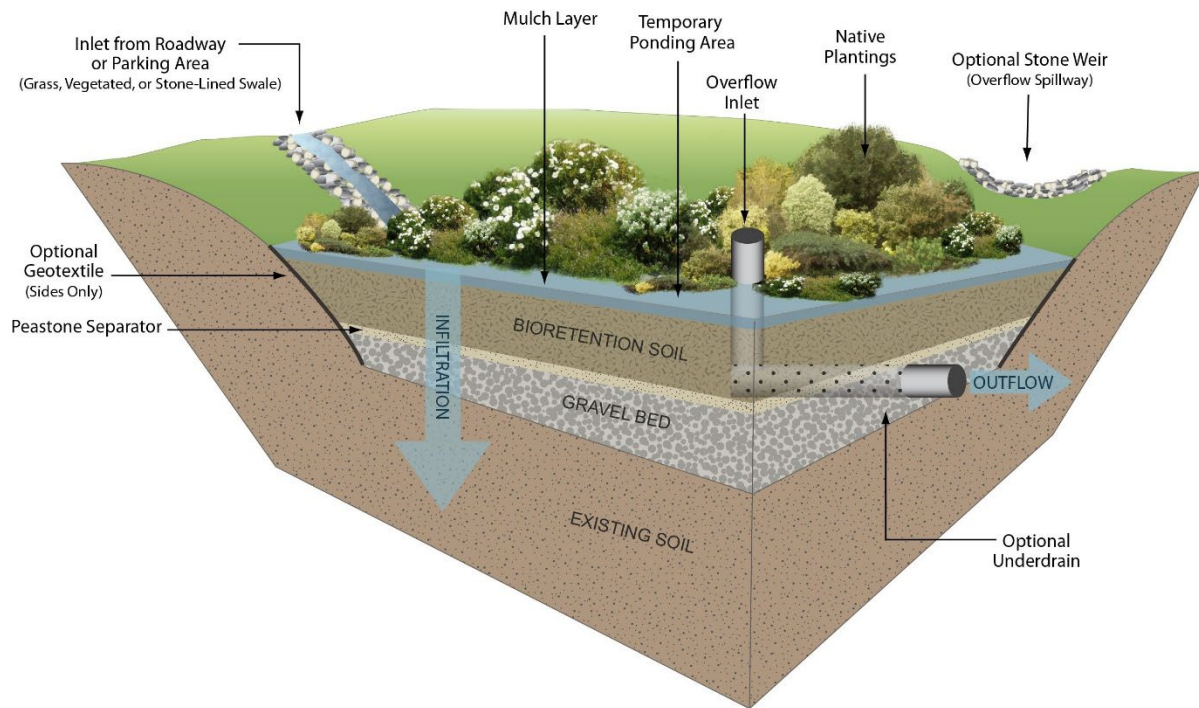


Peter C. Engle, P.E.
Senior Engineer

Attachments

cc: John P. Shelvin, P.E., Pare Corporation, 10 Lincoln Road, Suite 210, Foxboro, MA 02035

Rain Garden (Bioretention)



Rain Gardens (also referred to as bioretention cells) use soil, plants and microbes to treat stormwater before it is infiltrated or discharged. Rain Gardens are typically shallow depressions filled with a mixture of organic compost and sandy soil (soil media), topped with a layer of mulch, and planted with dense vegetation.

Unlike detention basins, which hold back and release runoff at the surface, or retention basins, which maintain a permanent pool of water, rain gardens are designed to dewater through both infiltration and evapotranspiration. Infiltration and detention basins are often larger, have less plant material, and look more like a meadow instead of a structured garden. Rain gardens, however, are typically smaller and place a heavier emphasis on aesthetics. In addition to improving water quality and reducing runoff, they're designed to be an attractive and eye-catching space.

Stormwater runoff flows into the rain garden, percolates through the soil media (which acts as a filter) and eventually infiltrated into the ground. Water is also absorbed by the plants root systems for use by the plant. Water also evaporates from the rain garden surface. Rain gardens are usually designed to allow ponding of water during larger storm events and with an overflow outlet to prevent flooding. Where soils have low permeability or where faster drainage is desired, designers often incorporate outlet control structures and underdrains.

Rain gardens provide excellent pollutant removal and recharge for the "first flush" of stormwater runoff (90% TSS removal credit per MassDEP). Properly designed rain gardens will remove suspended solids, metals, and nutrients. Distributed around a property, rain gardens enhance site aesthetics. In residential developments they are often marketed as property amenities. Routine maintenance is simple and can be handled by homeowners or conventional landscaping companies, with proper direction.

Bioretention areas are suitable in a wide range of climatic and geologic situations. Common applications for bioretention areas include parking lot islands, median strips, and traffic islands. On residential sites bioretention areas are commonly used for rooftop and driveway runoff.

Advantages/Benefits:

- Can be designed to provide groundwater recharge and preserves the natural water balance of the site.
- Can be designed to prevent recharge where appropriate.
- Supplies shade, absorbs noise, and provides windbreaks.
- Can remove other pollutants besides TSS including phosphorus, nitrogen and metals.
- Can be used on small lots with space constraints
- Small rain gardens are mosquito death traps
- Little or no hazard for amphibians or other small animals

Effectiveness

Bioretention areas remove pollutants through filtration, microbe activity, and uptake by plants; contact with soil and roots provides water quality treatment better than conventional infiltration structures. Studies indicate that bioretention areas can remove from 80% to 90% of TSS. If properly designed and installed, bioretention areas remove phosphorus, nitrogen, metals, organics, and bacteria to varying degrees.

Bioretention areas help reduce stress in watersheds that experience severe low flows due to excessive impervious cover. Low-tech, decentralized bioretention areas are also less costly to design, install, and maintain than conventional stormwater technologies that treat runoff at the end of the pipe.

Decentralized bioretention cells can also reduce the size of storm drain pipes, a major component of stormwater treatment costs. Bioretention areas enhance the landscape in a variety of ways: they improve the appearance of developed sites, provide windbreaks, absorb noise, provide wildlife habitat, and reduce the urban heat island effect.

In Massachusetts, with an annual rainfall of roughly 45 inches, one rain garden receiving runoff from a 1000 square foot area, can treat and recharge 25,000 gallons of water each year. If 40 rain gardens are installed in a neighborhood, 1 million gallons would be saved each year.

Cold Climate Considerations

Never store snow in bioretention areas. When bioretention areas are located along roads, care must be taken during plowing operations to prevent snow from being plowed into the bioretention areas. During icy conditions in winter, pavement and asphalt are treated with ice removal chemicals that typically include salts like sodium chloride or magnesium chloride. While rain gardens filter out these chemicals from the stormwater, rain gardens which treat polluted runoff that contains salt should be designed with salt-tolerant non-woody native plants.

Winter Rain Garden Studies

Forest Lake, MN (Average High Temperatures of 23° and 30° in January and February)

“During 2008, the Washington Conservation District, local watershed organizations and the county created more than 50 new raingardens in Washington County, MN. In the summer, these gardens bloom vibrantly, attracting birds, bees and other pollinators. Even in the fall, many of the gardens retain their color, as late blooming asters turn purple and prairie grasses burn red and orange. What happens in January, though, when these raingardens lie two feet under the snow? Most raingardens feature plants native to Minnesota, which are well adapted to our seasonal changes. During the winter, the plants may appear brown and dead, but underground the root systems are still alive, feeding off stored energy from the summer and fall. Above ground, the seed heads and stalks provide food and shelter for birds and hibernating insects. Minnesota plants can remain dormant for months during the winter, but when spring arrives, the roots soon begin to grow again and the new year’s flowers and leaves are usually bigger and healthier than the year before. New research now shows that most raingardens continue to absorb water even in the winter. A joint project conducted by the Washington Conservation District, Dakota Soil and Water Conservation District, Ramsey Washington Metro Watershed District and Emmons and Olivier Resources, Inc. tracked four raingardens over the course of three winters. Field staff used monitoring equipment to measure infiltration rates in the gardens throughout each winter and simulated large snowmelts by periodically flooding the gardens with 200-6,000 gallons of water. The study found that three of the four raingardens infiltrated water into the ground 85 percent of the time. The fourth raingarden, which rarely infiltrated water during the winter, also performed poorly during the summer due to faulty design and construction.” – Comfort Lake& Forest Lake Watershed District

Trondheim, Norway (Average High Temperatures of 34° and 36° in January and February)

“This paper evaluates the performance and winter hydrology of two rain gardens in a cold climate coastal area, in Trondheim, Norway. The rain gardens received runoff from a small residential watershed over a 20 month study period. The objective of the study was to investigate to what extent the cold climate conditions would influence the hydrology and performance of the rain garden. The hydraulic retention, storm lag time and peak flow reduction was measured and compared between the seasons. No significant difference was found on either hydraulic retention time, lag time or peak flow reduction between the seasons. The rain garden performance with respect to hydraulic function was not impacted by the climatic factors experienced during the cold season.” – Norwegian University of Science and Technology

Curb Entrances to Rain Gardens



Rain Garden Overflows



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We have a clarity of purpose for our business: to challenge conventional thinking and disrupt traditional paving methods; to ultimately create a better, cleaner, less toxic environment for our kids.

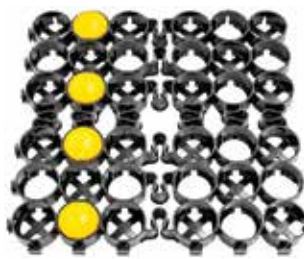
By offering a simple new green technology that is easily actionable, together we can make an impact now. Less flooding. Cleaner air and water. Less heat. Less thermal pollution. Less waste in the landfill. Fewer toxins from runoff pollutants as well coal tar & asphalt. A more natural landscape.

PRO LITE



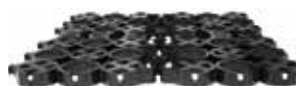
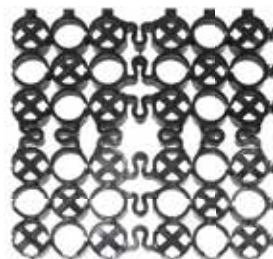
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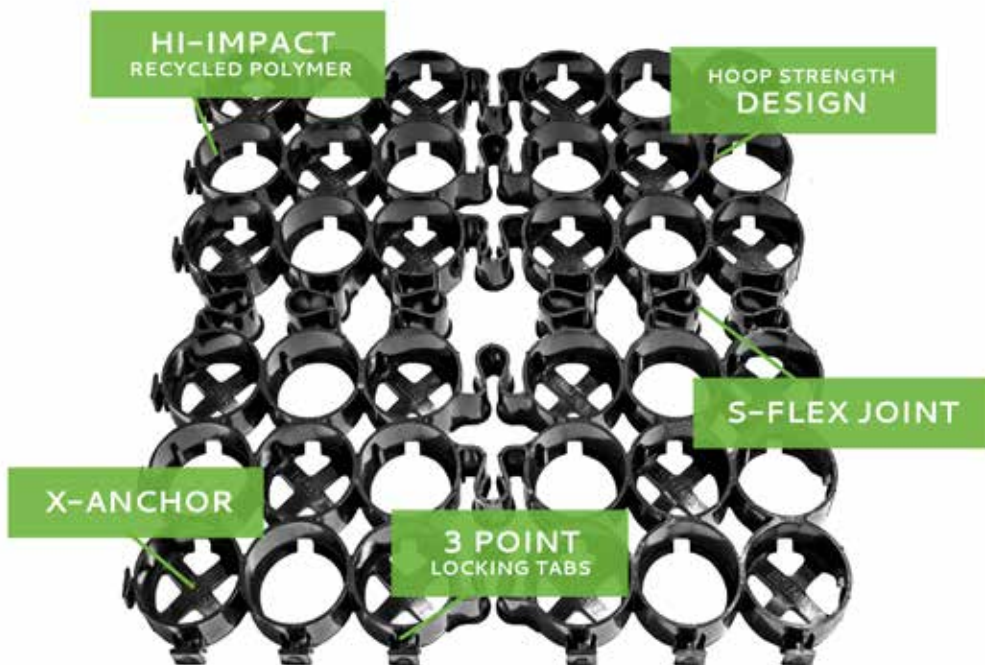
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DESIGN FEATURES



U.S. Patent No. 8,734,049

The robust cells allow our 2 lb grid to handle over 1 million lbs per square foot load! No gravel migration, compaction or dust. **100% permeability.** The grid can be pressed together by hand, no tools, no clips. With the integral X-anchors, no staking is needed. A bottom flange prevents sinking. Other systems are either too flexible & weak & can't handle trucks or traffic; or too rigid because soils move and paving cracks! The S-Flex Joints solve these problems giving our grid the best of both. A versatile design for any climate or soil or weight or traffic load.

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GRAVEL FILL



GRASS FILL

INTRODUCTION TO THE TRUEGRID SYSTEM



In urban watersheds, almost all of the impervious surface area is represented by building rooftops and paved surfaces. In residential areas most of the paved area is represented by the roadway system and residential driveways. Parking lots and paved industrial storage areas represent an even larger portion of the impervious surface in commercial and industrial areas. Impervious pavements can produce two-thirds of the excess runoff in an urban catchment. Runoff from impervious pavements contributes a substantial loading of hydrocarbons and heavy metal pollutants, and contributes greatly to the increased temperature of surface runoff. In most urban jurisdictions, a paved roadway system with a traditional curb and gutter configuration provides a key component of the overall urban drainage system. Surface flow from adjoining tributary watersheds is conveyed directly into catch basin inlets and connected piping systems. In these traditional impervious paved systems, the runoff coefficient (runoff volume) is increased and the time of concentration is decreased resulting in increased peak rates of runoff. TRUEGRID provides a highly permeable stabilized surfaces that can be used for the movement and parking of vehicles (automobiles, trucks, construction equipment, aircraft, etc.) and storage of materials and equipment.

Drive on the surface, drain & detain stormwater below.

Compared to conventional pavement, the TRUEGRID system is designed to infiltrate storm water runoff instead of shedding it off the surface. TRUEGRID will reduce the amount of runoff by allowing water to pass through surfaces that would otherwise be impervious. The storm water passes through the load bearing surface and aggregate sub base that are selected based upon the intended application and required infiltration rate. Runoff is stored in the stone aggregate sub base course / storage layer, and allowed to infiltrate into the surrounding soil (functioning like an infiltration basin).

A TRUEGRID surface has very high initial surface infiltration rates and can immediately infiltrate and store rainfall and runoff from high intensity rainstorms. In many cases, direct runoff is completely eliminated. The surface infiltration rates for TRUEGRID will in most cases exceed 800 inches/hour. This is several orders of magnitude higher than all the rainfall intensities encountered in the Southwest and Midwest USA.



Compared to conventional pavement, the TRUEGRID system is designed to infiltrate storm water runoff instead of shedding it off the surface. TRUEGRID will reduce the amount of runoff by allowing water to pass through surfaces that would otherwise be impervious. The storm water passes through the load bearing surface and aggregate sub base that are selected based upon the intended application and required infiltration rate. Runoff is stored in the stone aggregate sub base course / storage layer, and allowed to infiltrate into the surrounding soil (functioning like an infiltration basin).

SUB-BASE CONSIDERATIONS FOR STORM WATER DETENTION

Crushed aggregate meeting ASTM No. 57 is commonly used for open-graded sub bases along with ASTM No. 2 to No. 4. These materials are widely available and they are recommended for most TRUEGRID Permeable Paver applications. These materials will have a nominal porosity (volume of voids/total volume of base) over 0.32 and a storage capacity in the void space (volume of voids/volume of aggregate) approaching 40%. A 40% void space provides 0.4 cubic feet of storage capacity for each cubic foot of aggregate (the volume of the base will need to be 2.5 times the volume of water to be stored).

Sub-Base for Grass Infill Installations. Should be a $\frac{3}{4}$ " minus, sandy gravel road base. Although reducing the stormwater storage capacity to around 20%, this base will grow grass, support heavy loads, and drain.

CHART A: PERMEABLE BASE

AASHTO #57 PERMEABLE SUB-BASE MATERIAL DEFINED AS:

SIEVE SIZE		PERCENT PASSING	
MM	IN	#57	TYPICAL
37.5	1½	100	100
25	1	95 - 100	97
19	$\frac{3}{4}$		75
12.5	$\frac{1}{2}$	26 - 60	45
9.5	$\frac{3}{8}$		25
4.75	#4	0 - 10	5
2.36	#8	0 - 5	2

ENDLESS GRAVEL FILL OPTIONS



THE VALUE TO THE TRUEGRID SYSTEM

Runoff volume reduction/elimination is achieved when TRUEGRID is placed over in situ soils and a defined volume of the water passing through the pavement is infiltrated into the angular stone base and soil subgrade below.

Peak runoff rate reduction is achieved when the volume of water passing through the TRUEGRID surface is “detained” for a defined period of time within the pavement cross-section and the open graded aggregate sub base beneath the pavement. The effective infiltration rate for the watershed is increased by trapping the water in the permeable surfaces and effectively increasing the time of concentration in the catchment area.

Pollutant removal. Infiltration of storm water runoff through the pavement surface will provide a degree of suspended solids removal followed by additional removal of colloidal solids and soluble pollutants in the aggregate sub base and sub soils. Sorption of metals to colloidal solids and within the pavement void matrix is another removal function. Soluble organic pollutants adsorbed within the pavement void matrix and the open graded aggregate sub base will be exposed to biodegradation over time.

TYPICAL POLLUTANT REMOVAL (%)

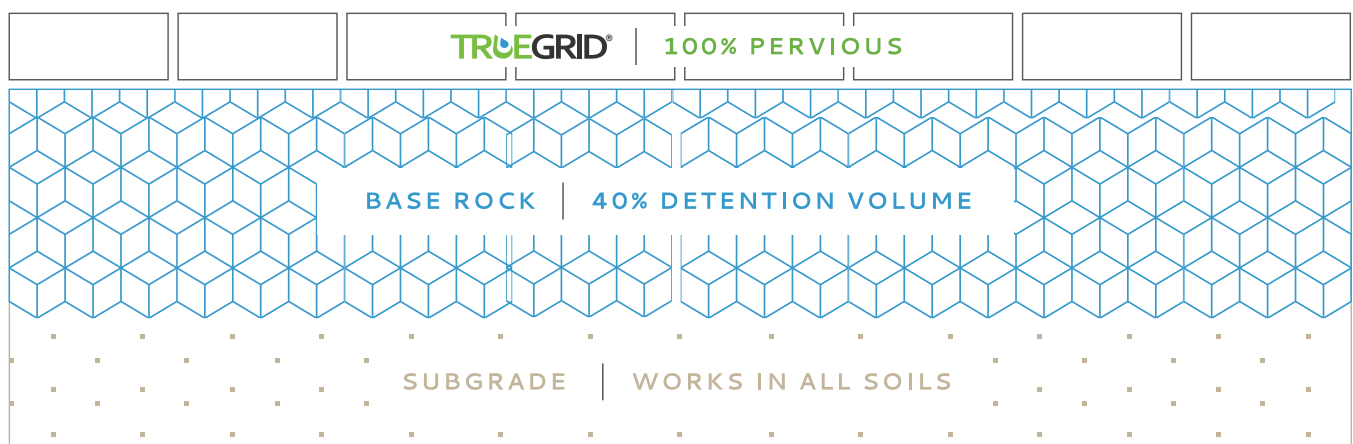
BMP TYPE	SUSPENDED SOLIDS	NITROGEN	PHOSPHOROUS	PATHOGENS	METALS
TRUEGRID	65 - 100	65 - 100	30 - 65	65 - 100	65 - 100
Dry Retention Basins	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65	< 30	50 - 80
Constructed Wetlands	50 - 80	< 30	15 - 45	< 30	50 - 80
Infiltration Basins	50 - 80	50 - 80	50 - 80	65 - 100	50 - 80
Infiltration Trenches / Dry Wells	50 - 80	50 - 80	15 - 45	65 - 100	50 - 80
Grassed Swales	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Vegetated Filter Strips	50 - 80	50 - 80	50 - 80	< 30	30 - 65
Surface Sand Filters	50 - 80	< 30	50 - 80	< 30	50 - 80

Reduces Heat Island Effect. Heat Island Effect occurs in areas such as a city and industrial sites that have consistently higher temperatures than surrounding areas because of greater retention of heat. This retention of heat is due to buildings, concrete, and asphalt. Using TRUEGRID in these “hot spot” areas for pathways, parking lots, driveways, roofs...etc., reduces the absorbability of solar rays and thus helps steady and cool the natural environment.

High load bearing capacity. TRUEGRID is designed with the highest load capacities of any grid system and can withstand significant structural loads. TRUEGRID provides a stable and continuous load-bearing surface throughout parking areas.

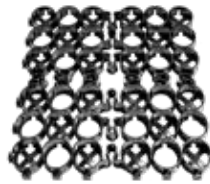
COMPETITION COMPARISON

SPECIFICATION	TRUEGRID	ROLL-OUT PLASTIC PAVERS	CONCRETE PAVERS
Strength (filled)	9510 psi	5730 psi	5000
Flexural Strength	High	None (rolled paver)	High
Weight (lbs/sf)	1.32	0.42	37
Tensile Strength	2852 lbs	458 lbs	NA
Fill rock size	Up to 1"	Up to ¾"	NA
Staking	Not Required	Required	NA
Installation	1000 sf/hr	NA	Slow
Recycled content	100% post consumer	100%	0
Porosity	90%	90%	37%
Wall thickness	.250"/.150"	.104"	NA
Paver depth	1.8"	1.0"	2"
Cell Size (ID)	3.2"	2.15"	NA
Flexibility	Rigid w/ Flex joints	Flexible	Rigid
Adjoining cell walls	Yes	No	No
Flex joints	Yes	No	No
Joint type	Tab	Snap	None
Shear Transfer Strength	High	Low	None



GREEN

TRUEGRID Permeable Pavers are designed to provide design professionals with an eco-friendly alternative to concrete and asphalt and other impervious surfaces. Similar systems have been used in Europe for over 40 years and have been highly effective and accepted as a better alternative to impervious surfaces. TRUEGRID improved upon this concept and developed a stronger, more durable, USA made version that can handle any load and rigors concrete can handle....while being 100% permeable.



Made from 100% post-consumer recycled HDPE.

100% Permeable. Up to 100% of runoff water pollutants are removed via bioremediation.

Impact Scorecard

MEASURE THE DIFFERENCE



150K^{SF}
600 Car Lot

CO2 SAVED

967^{TONS}



PLASTIC RECYCLED

204K^{LBS}



STORMWATER DETAINED

40K^{CUBIC FT}



LEED Credit Opportunities

With **TRUEGRID**



STORMWATER
MANAGEMENT



RECYCLED
CONTENT



INNOVATION
& DESIGN



MATERIALS
& RESOURCES

Tons of CO2 emissions from the manufacturing of cement are eliminated. Millions of lbs of plastic are kept out of landfill and recycled from a consumable to a 60 year life cycle useful product. Detention is added and flooding from stormwater is reduced. Coal tar & asphalt toxins are eliminated.

TRUEGRID has kept more than **12,000,000 lbs** of plastic out of landfills ...so far

PRODUCTS

TRUEGRID® PRO LITE

THE RESIDENTIAL PAVER



- Superior Patented Design
- Excellent Compression Strength. Best-in-class.
- Low traffic applications
- H20, HS20 Rated

SPECIFICATIONS:

- | | |
|-------------------------|---|
| · Dimensions: | 24" x 24" x 1.0" (4 sf) |
| · Pre-Assembled: | 16 sf per layer (4' x 4' sheet of 4 grids) |
| · Compression Strength: | 6200 psi filled. |
| · Permeability: | 100% |
| · Material: | 100% Post-Consumer Recycled HDPE |
| · Color: | Black with UV Stabilizer (Other Colors Available) |

MORE:

- No Staking or Clips
- Works in All Climates & Soils
- May be Saw Cut
- Grass or Gravel Fill
- High Heel Friendly



SUPERSPOT® AVAILABLE

APPLICATIONS:

- Driveways
- Parking lots
- Event Parking
- Firelanes
- Grass Overflow Parking
- Community Green-Space
- Golf Cart Paths
- Walk/Bike Trails
- Pathways



PRODUCTS

TRUEGRID® PRO PLUS®

THE COMMERCIAL PAVER



- Works with SuperSpot® Parking Markers
- Superior Patented Design
- Engineered for Heavy Loads & Heavy Traffic
- Industry-Best Strength
- Industrial or Commercial Applications
- H20, HS20 Rated

SPECIFICATIONS:

- Dimensions: 24" x 24" x 1.8" (4 sf)
- Pre-Assembled: 16 sf per layer (4' x 4' sheet of 4 grids)
- Compression Strength: 9510 psi filled
- Permeability: 100%
- Material: 100% Post-Consumer Recycled HDPE
- Color: Black with UV Stabilizer

MORE:

- No Staking or Clips
- Works in All Climates & Soils
- May be Saw Cut



COMMERCIAL APPLICATIONS:

- Parking Lots
- Equipment & Truck Yards
- Storage Lots
- Drive Lanes
- Roadways
- Fire Lanes
- Rig Sites
- Event Parking





SuperSpot® for TRUEGRID PRO PLUS

- Maintenance-Free Parking Markers
- Delineate Parking for Max Efficiency
- Create Arrows & Traffic Flow Markers
- High Visibility Profile
- Heavy Loads, Heavy Traffic
- Easy Snap-Lock Installation
- Never Stripe Again

SPECIFICATIONS:

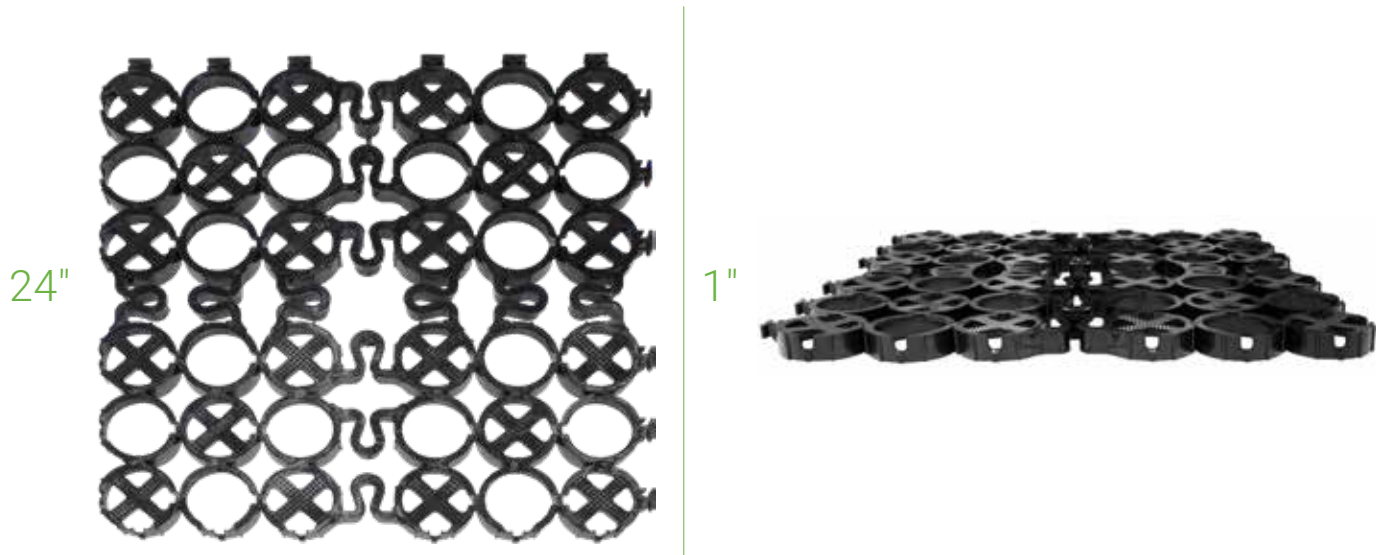
- Support Ribs for Strength
- 0.90" Domed Profile
- UV Stabilized

PRODUCTS

TRUEGRID® ROOT™

 NEW PRODUCT

THE GRASS PAVER



- Advanced Patented Design
- Protects Grass from Rutting
- Fast, Easy Installation
- Usually Costs Less than Asphalt

SPECIFICATIONS:

- | | |
|------------------|---|
| · Dimensions: | 24" x 24" x 1.0" (4 sf) |
| · Pre-Assembled: | 16 sf per layer (4' x 4' sheet of 4 grids) |
| · Strength: | Holds up to 10,000 lbs GVW |
| · Permeability: | 100% |
| · Material: | 100% Post-Consumer Recycled HDPE |
| · Color: | Black with UV Stabilizer (Other Colors Available) |

MORE:

- Only Available Immediate Heavy Load Grass System
- Stabilized Grass Drains. No Runoff.
- 100% Recycled Plastic
- Little or No Maintenance
- 60-Year Lifespan

APPLICATIONS:

- Grass Parking for Cars & Trucks
- Festival Site Protection
- Light Aircraft Runways & Taxiways
- Event Centers
- Paths & Trails
- Slope & Scour Protection
- RV & Boat Storage & Access
- Fairground Turf Support



PRODUCTS

TRUEGRID® MACK™

THE INDUSTRIAL PAVER



1.5"



EARTH GRABBING TEETH



- Double Wall I-Beam Construction
- Unique Patented Design
- Gridlock™ positive locks
- Earth grabbing teeth for torque strength
- Gripping traction tread surface
- 100% effective permeability
- Deep Cells for Gravel Containment

SPECIFICATIONS:

- Dimensions: 24" x 24" x 1.5" (4 sf)
- Pre-Assembled: 16 sf (4' x 4') Sheets (4 grids per sheet)
- Permeability: 100%
- Material: 100% Post-Consumer Recycled HDPE
- Color: Black with UV Stabilizer

MORE:

- No Staking or Clips
- Works in All Climates & Soils
- May be Saw Cut
- 20 + Year, Virtually Maintenance Free Life

SUPERSPOT® AVAILABLE



APPLICATIONS:

- Roadways
- Construction Site Access
- Truck terminals & sites
- Heavy Traffic Drive lanes
- Military
- Extreme Applications
- Dust Control
- Service Roads

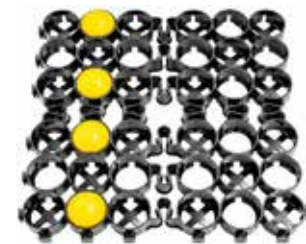


ACCESSORIES

SUPERSPOTS®

MAINTENANCE-FREE PARKING DELINEATORS

Delineate your parking spots with easy-to-pop-in SuperSpot parking markers. No-restriping. Long-term UV resistance. Multiple color options for standard parking, fire lanes, handicapped designated spaces. Highly visible.



PRO PLUS



PRO LITE



MACK



SNOWSPOTS™

MAINTENANCE-FREE PARKING DELINEATORS

Delineate your parking spots with easy-to-pop-in SnowSpot parking markers. Flush with surface for worry-free snow plowing. No restriping. Long term UV resistant. Yellow or white for standard striping, blue for disabled-access spaces and red for firelanes.



SNOWSPOTS



The Plate™

EASY-TO-USE PARKING SPOT IDENTIFIER FOR PRO PLUS

Identify your spaces with easy-to-pop-in PLATE markers. Long-term UV resistance. Multiple color options for standard signs. Highly visible. *Patent Pending*

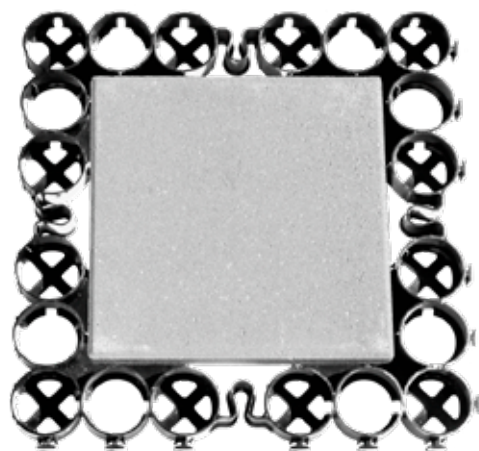


7.5"



ACCESSORIES

TRUEGRID® DECO™



A modular décor element, the TRUEGRID DECO adds functional nuance to your design. Use square, round or irregular shaped step stones to build walkways, ribbon driveways or any stepping area to add character to your project. Use DECO alone or attach to the TRUEGRID PRO PLUS paving system to create unique projects that are not only pleasing to the eye but sustainable.

FEATURES:

- Fits most 16" x 16" x 2" or smaller stone pavers
- 100% Post-Consumer Recycled HDPE
- Fits square, round or any irregular shaped stones
- Connects with TRUEGRID PRO PLUS
- Border cells allow for gravel or grass fill
- Drain through and detain under grid
- Stone paver not included



SPECIFICATIONS:

- | | |
|------------------|---|
| · Dimensions: | 24" x 24" x 1.8" (4 sf) |
| · Pre-Assembled: | 16 sf (4' x 4') sheets (4 grids per sheet) |
| · Permeability: | 100% |
| · Material: | Recycled High Density Polyethylene (100% post-consumer) |
| · Color: | Black with UV Stabilizer |

APPLICATIONS:

- Walkways
- Driveways
- Poolside
- Garden Paths
- Light Commercial Parking
- Dog park paths
- Common areas walks
- Patios

ARCHITECTS



“Man is a phase of nature, and only as he is related to nature does he matter, does he have any account whatever above the dust.”

Frank Lloyd Wright

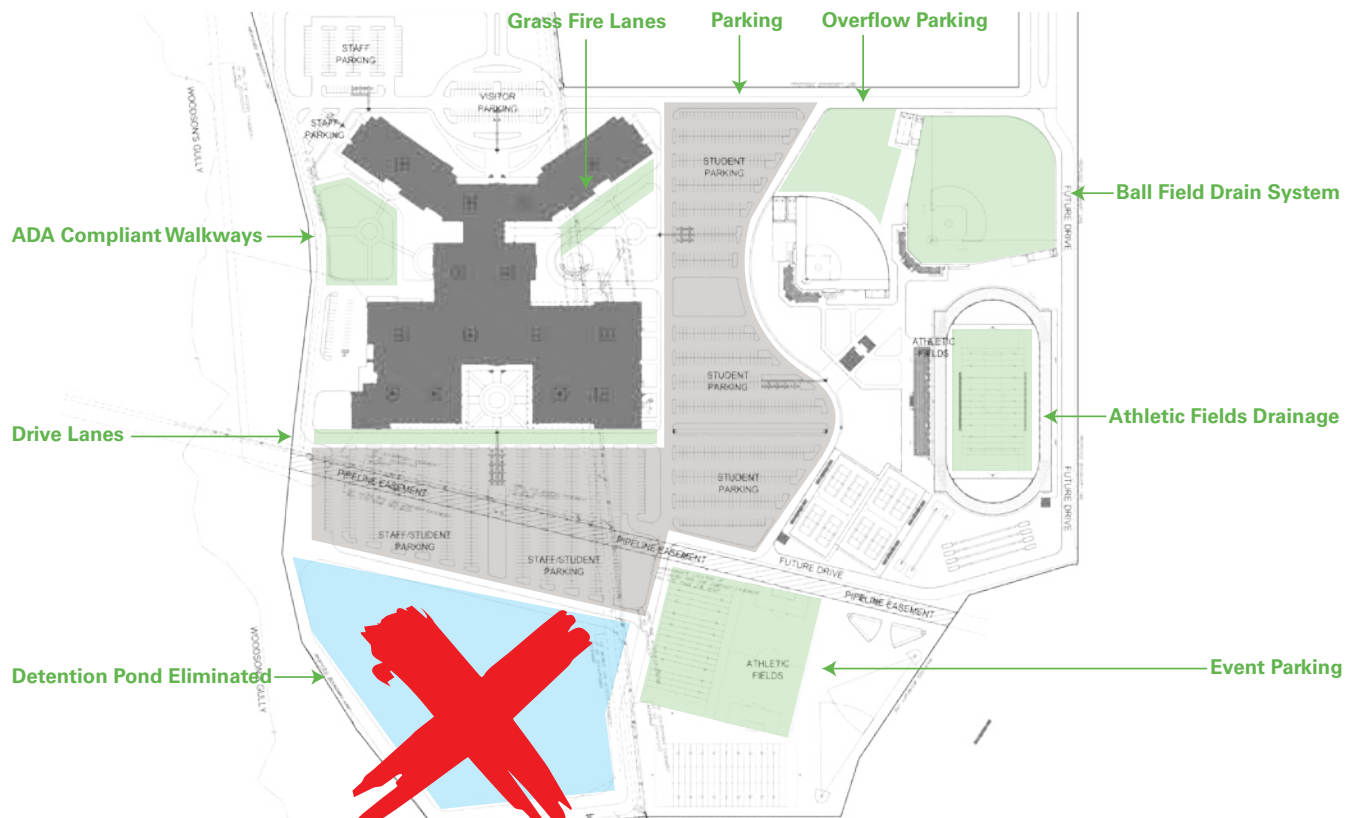
Endless Gravel Fill Options:



- Beauty
- Performance
- Sustainability

Achieve harmony & balance development with nature. Gain space for inspired functionality & green, creative livability. Retain & reuse stormwater onsite. Natural, upscale aesthetic. ADA compliance. Design with TRUEGRID.

DEVELOPERS



- 100% Land Utilization
- Durable & Pervious Cover
- Dollars

Save land & eliminate or reduce detention ponds. Drive on surface with detention under your parking lot. Maintenance-free 25 to 60 year life. Heavy traffic, heavy loads. TRUEGRID counts as 100% pervious cover. Construction costs up to 30% less than concrete. Sustainable, upscale natural aesthetic. LEED eligible. Build with TRUEGRID.



"Buy land, they're not making it anymore."

Mark Twain

ENGINEERS



- Detention
- Durability
- Dollars

“ Some people don’t like change, but you need to embrace change if the alternative is disaster.”

Elon Musk

Control flooding and manage stormwater. Best-in-class, engineered strength, structure & soil stabilization with TRUEGRID. Heavy traffic, heavy loads. H20, HS20 rated. 25+ year life. Save on construction costs (up to 50%) and land. Specify TRUEGRID.

CITY PROFESSIONALS



- Stormwater Management
 - Urban Heat Island (UHI) Reduction
 - Functional Green-Space
-

Reduce flooding and manage stormwater with TRUEGRID. Added detention volume. 100% pervious cover. Improved water quality & more parking. Cooler than asphalt or concrete. No gravel migration. Key tool in federal (EPA), state, county and city LID (Low Impact Development) guidelines and BMPs. Code with TRUEGRID.

1. Stormwater Detention Underneath



FLODOT UNDERPASS PROJECT

2. Drive on Durable Surface



CONTRACTORS



- Advantageous Price & Service Differentiator
 - Eco-Friendly Offering
 - Easy-to-Install
-

Gain a cost and speed advantage over conventional paving. Differentiate from competitors as a preferred TRUEGRID installer with a green, pervious, coded, less expensive paving system. Pave with TRUEGRID.

1. Grade the site



2. Lay, compact base



3. Drop the grid



4. Fill the grid



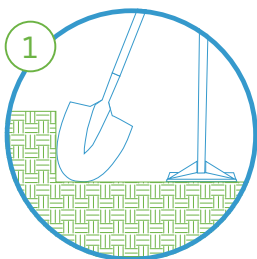
HORSE, LIVESTOCK, RANCH & FARM



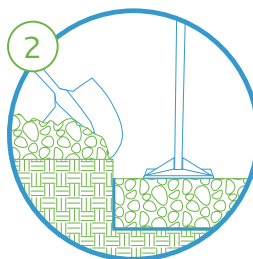
- Stops Mud in Paddocks. Maintenance-Free.
 - Thrush-Free Healthy Hooves.
 - No Standing Water. Drains Instantly.
-

TRUEGRID PRO PLUS® for Equine, Farm, & Ranch use offers an advanced patented design. Strong for heavy loads. Clydesdales to John Deere. Patented S-flex joints allow “crowning” of paddock surface for instant water draining. Stops digging. No ruts, mud or dust. Drains instantly. No standing water. Keeps area level or crowned as desired. Urine drains, reducing odor. Keeps bedding dry. No bacteria buildup. Supports heavy equipment loads & traffic.

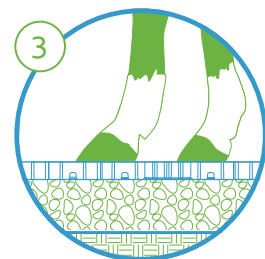
1. Scrape back, level, compact the area.



2. Lay filter fabric and ¾" minus base rock.



3. Lay PRO PLUS grid. Fill with soil.



WORKS IN ALL CLIMATES AND SOILS

STORM WATER DETENTION



100% PERVIOUS COVER



1000+ INCHES/HOUR INFILTRATION RATE

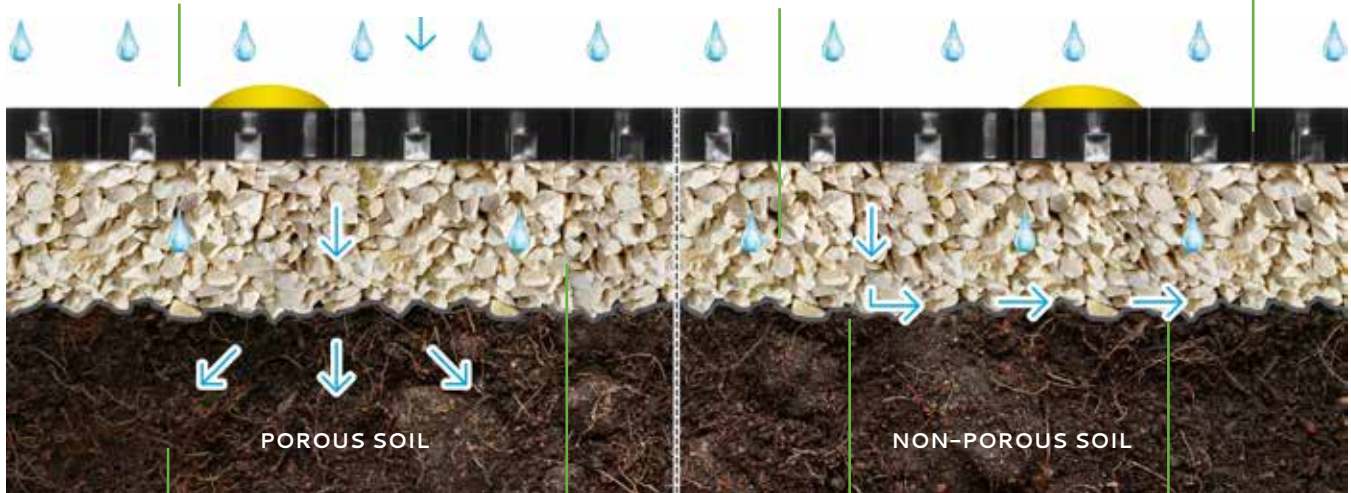


0.0 - 0.05 RUNOFF COEFFICIENT

CLEAN / WASHED ANGULAR AGGREGATE

STORM WATER INFILTRATION

SUB-BASE DEPTH CAN VARY FOR LOADING OR STORM WATER DETENTION REQUIREMENTS



STORM WATER NATURALLY PERCOLATES INTO SOIL

40% VOID SPACE ALLOWS FOR STORM WATER STORAGE

GEOTEXTILE FABRIC

SHEET FLOW OR DIRECT USING PERFORATED PIPE

HOW TO CALCULATE STORM WATER DETENTION CAPACITY

Detention Capacity = TRUEGRID Area (A) x Total Aggregate Depth (d) x 40% Void Space = $A \times d \times 0.40$

WHERE:

d = Depth of Sub-base + TRUEGRID Height

EXAMPLE:

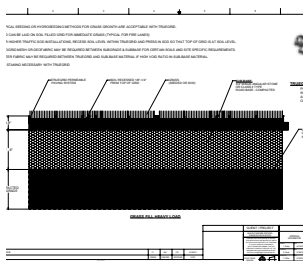
1 Acre Lot, TRUEGRID PRO PLUS, 8in Sub Base Fill & Sub Base - 3/4" Clean/Washed Angular Stone
Detention Capacity = $A \times d \times 0.40$

WHERE:

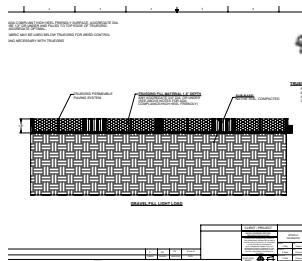
A = 1 Acre = 43,560 sf
d = 8 in + 1.8 in = 9.8 in = 0.8 ft
Detention Capacity = $43,560 \times 0.8 \times 0.4 = 13,939$ cf

Go to TECHNICAL INFO on TRUEGRIDpaver.com for typicals. Call for site specific questions: 1-855-355-GRID (4743)

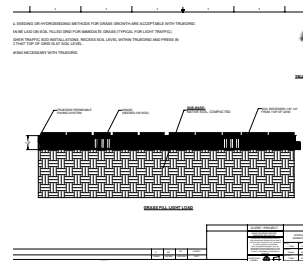
1. Grass Fill Heavy Load



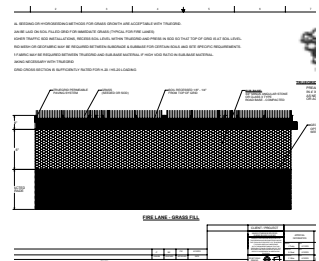
2. Gravel Fill Light Load



3. Grass Fill Light Load



4. Fire Lane





PROJECTS

SUPERBOWL LI® – CLUB NOMADIC® POP-UP NIGHT CLUB

- 62,500 SF Parking Lot Installed in 10 Days
- 3-Story Metal Nightclub Installed in 60 Days
- 100% Land Use - TRUEGRID Lot Eliminated Detention Pond



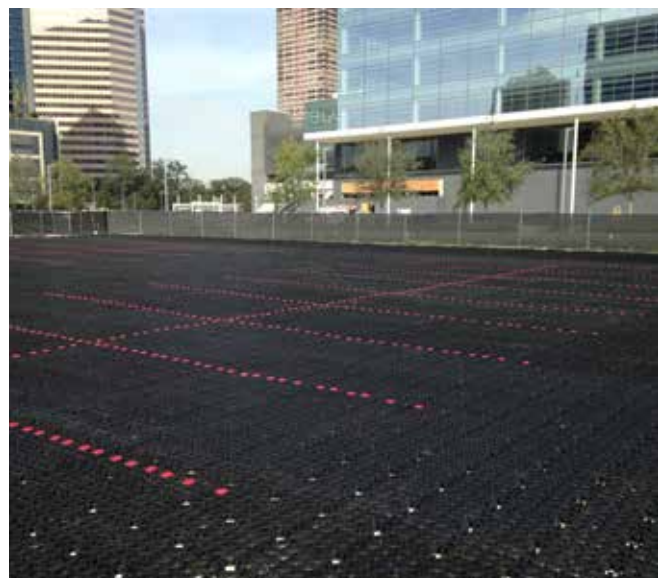
PROJECTS



Whole Foods Market®

"Great product. Went in quick. Our ADA compliant lot was down in time for the holidays."

John Fox (Construction Supervisor)



PROJECTS



Google®

FACT

TRUEGRID was tested and chosen over all other paving options by site engineers for Google at the Mountain View campus. Eco-friendly, durable and 100% permeable.



Pocono Raceway®—NASCAR®

"The new installed walkways were a huge success with our fans. The ease of installation and maintenance... we intend to once again use TRUEGRID Pavers throughout. It's a great product and fits in with our sustainability efforts."

Brandon Igdalsky – CEO

PROJECTS



Fire Lane

"We've completed all the tests. As far as supporting the truck as a driving material, we didn't have any issues there. When we set the outriggers up, in a normal operation with the pads underneath the outrigger, we were able to take the truck to its extreme test with all the weight all on one side. So that test was a success. We then took the outriggers without the pads and to increase the concentrated load on the system. It even supported those."

Fire Chief McCaskill



Self-Storage

"We got pervious cover credit for our entire lot and eliminated the entire 2.5 acre detention pond."

Hank Daughtry - New Braunfels Self Storage

PROJECTS



U.S. Military

"They spec TRUEGRID because of the its eco-friendliness as well as strength to handle anything."

Chris Smith- Gilmore Environmental Consulting



Industrial

"Our trucks and equipment don't get stuck anymore when it rains. The grid keeps us working."

David Bourgeois – (Purchasing Manager) Petrochem

PROJECTS



ROCKSTAR Energy Bike Park

The North Houston ROCKSTAR Energy Bike Park is the Largest BMX bike park in North America. 150K sf of PRO PLUS were spec'd and installed for 100% pervious cover, stormwater detention and the natural aesthetic that compliments the park.



NOCI Sonoma Edible Garden

TRUEGRID works in harmony with nature on a beautiful California site to blend seamlessly while allowing the site to meet stormwater management code requirements. TRUEGRID was used on the roadways, work areas, pathways and patios.

PROJECTS



Snowplowing - Cold Climate Use

FACT

Snow melts faster on TRUEGRID and there is less ice buildup. TRUEGRID can be easily plowed, snow-blown or shoveled.



Wellington Aero Park

This aero club community stabilized their grass taxiways and perpendiculars to keep flying in all seasons and weather conditions. A better solution than asphalt, the grass-filled TRUEGRID looks naturally beautiful while supporting plane traffic.

TRUEGRID® CASE STUDY

PARKING LOT EXPANSION

AutoNation® car dealership increases inventory lot space while saving almost half a million dollars.

PROBLEM:

Design a solution that will allow AutoNation to expand its current car inventory lot without spending more money on land.

CHALLENGES:

High cost for concrete, detention pond and drainage system cost, maximize land utilization for space challenged dealership, stormwater detention requirements for site for flood prone areas.

SOLUTION:

100 extra spaces is a grand slam to the dealership. The entire detention pond was eliminated with the 100% pervious TRUEGRID system and by transferring all of the required stormwater detention volume into the base and the gravel filled grid. Rain infiltrates the surface at over 1000 inches/hour and there is no runoff. SuperSpot parking markers were used instead of striping paint for maintenance free stripping.

TRUEGRID® VS. CONCRETE

- Land Savings: 25,000 sq ft
 - Construction Cost Savings: \$480k
 - Elimination of separate detention pond
- 100% Pervious Cover Credit
 - 100% Land Utilization
 - Zero Stormwater Runoff
- 100 extra parking spaces gained on the 500 space lot



ESTIMATED SAVINGS USING TRUEGRID

CONSTRUCTION COSTS (SQ FT OVER ENTIRE SITE VS. CONCRETE)	DETENTION POND & DRAINAGE CONSTRUCTION SAVINGS	TOTAL SAVINGS
\$360,000	\$120,000	\$480,000

TRUEGRID® CASE STUDY

WORLD'S LARGEST PERMEABLE PARKING LOT

Manheim Auto saves four acres and improves urban heat and flood drainage conditions for Texas Hobby Clients and Community.

PROBLEM:

With a concrete design 4 acres of the 15.5-acre site were needed for a detention pond which would limit car storage capacity. Design a solution that will allow for more vehicle storage, combat concrete/asphalt heat and provide stormwater drainage relief in flood-prone Houston.

CHALLENGES:

To mitigate localized flooding, stormwater management code requires on-site detention. Not only does this limit land use, the high cost for concrete, detention pond construction and drainage is high. How to maximize land utilization for on-site vehicle storage, and meet stormwater detention requirements.

SOLUTION:

All 15.5 acres are now utilized for parking by using the PRO PLUS system with Stormwater detention under the parking surface. The 4-acre pond was eliminated. Manheim Texas Hobby now holds 1,000 more vehicles than before – a significant advantage for clients who do business at the location. And, since no runoff reduces the chance of flooding, clients' investments in their vehicles are better protected. The TRUEGRID environmentally-friendly solution leaves no runoff and filters naturally to remove harmful hydrocarbons and pollutants which protects local aquifers.

TRUEGRID® VS. CONCRETE

- Total Land Available 625,000 SF
- Total Land Utilized 625,000 SF
- Land savings by eliminating detention pond: 4 Acres

- 100% Pervious Cover Credit
- 100% Land Utilization
- Zero Stormwater Runoff

- 1,000 Additional Vehicles Stored On-Site
- Less absorbed and reflected solar radiation

ESTIMATED SAVINGS USING TRUEGRID

CONSTRUCTION COSTS
(SQ FT OVER ENTIRE SITE VS. CONCRETE)

\$754,000

DETENTION POND & DRAINAGE
CONSTRUCTION SAVINGS

\$265,000

TOTAL SAVINGS

\$1,019,000

“Design is not just what it looks like and
feels like. Design is how it works.”

STEVE JOBS



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