

MicroVerse

Documentation

All support is handled via discord, and access to the GitHub repositories can be acquired by registering MicroVerse modules with our GitHub bot.

[Discord Group](#)

If you own the Core Collection, a demo package is also installed in your package area. If you have bought the MicroVerse, Splines, and Vegetation module independently, you can download that demo from here:

[Demo Github Repository](#)

Installing Splines on 2021

Please see the readme in the MicroVerse-Spline's package to install the Unity splines package on 2021, as it is normally only available in 2022 or greater.

Intro

MicroVerse is a set of scene creation tools which operate entirely in real time. You won't have to wait while things bake, or look through small preview windows to see your work. Every change happens as you make it, directly on the scene.

MicroVerse also embraces a non-destructive workflow. Want to move a mountain or road, just move it. Want to paint over an area with Unity's paint tools to customize it? No problem. Want to move a whole town including its terrain and texturing? Yup. Want to prefab any aspect of a terrain as a biome and simply drag it onto a new terrain? Trivial.

Core Concepts

MicroVerse works off a stamp based system.

- Stamps can affect a specific area, or in some cases everywhere.

- A stamp might represent placing a mountain, putting textures on slopes, spawning trees, or preventing trees from spawning in an area.
- Stamps can be filtered by the results of stamps before them. For instance, a texturing stamp can filter based on the height, slope, angle, or curvature of the height stamps computed before it.
- Stamps are applied in output order (all heights, then texturing, then tree's, then details), and then by their **order in the hierarchy**.

Setup

If you are trying to work with an existing terrain, please read the section on how to do that below before attempting it or you could erase your terrain data. If starting from scratch, follow these directions:

Add the MicroVerse script to an object in a new scene, or create it automatically from the GameObject/MicroVerse/Create MicroVerse menu item. Create new terrain(s), and parent them to the MicroVerse object. Only one MicroVerse can be added to a scene, and it only works with stamps and terrains below it in the hierarchy.

The Height Stamp

The height stamp moves mountains, literally. Once created, you can set a stamp image and it will deform the terrain based on its position, rotation and size. The height maps used should be saved as 16bit format files and set in the import settings as R16 files.

You can create a height stamp by right clicking in the hierarchy and selecting Create->MicroVerse->Create Height Stamp. Select a heightmap texture from the Examples/Common/HeightStamps folder and drag it into the Stamp slot on the component. You can move the stamp around and scale or rotate it to change the effect.



Height stamps have a blend mode, which is "Max" by default. When set to Max mode, the maximum value of any stamps in an area is taken for the final height. Other modes include:

- Min
 - Takes the minimum value of the stamps in the area
- Add
 - Adds the current stamp value to the ones before it
- Subtract
 - Subtract the current stamp value from any ones before it
- Multiply
 - Multiply the stamp value with the previous stamps result
- Override
 - Set the value to the absolute value of the stamp

Understanding Falloff:

Most stamps have a falloff control. The falloff controls what happens at the edges of the stamp. Some stamps can work globally (like texturing), where others are clamped to the edge of the stamp's bounding box. When set to Range, a circular area with ranges ramps the effect down as it approaches the edge of the stamp. You can also use a texture to define the area, and when the Spline module is installed you can create arbitrary areas for stamp effects.

The falloff system makes biomes intrinsic to the system, since you can define the range of an effect.

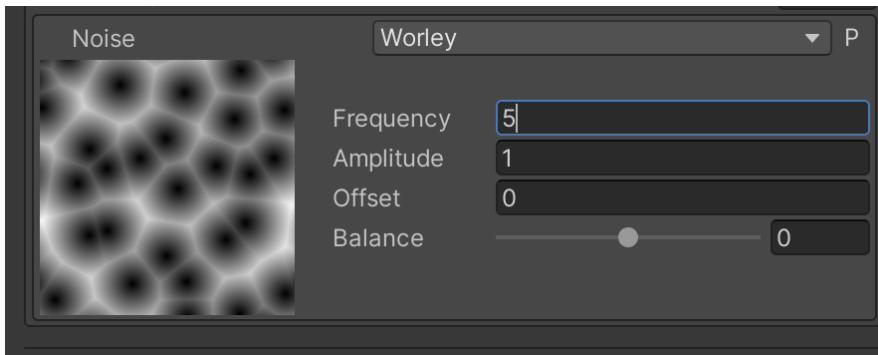
Texture Stamp



The texture stamp applies textures to your terrains. Textures are applied in hierarchy order, with textures lower in the hierarchy being applied first until the weight is used up. You can think of these as similar to layers in photoshop. You can assign a terrain layer file to the layer property to select a texture, and MicroVerse will automatically add only the textures needed for a specific terrain to the terrains that use it.

The weight of each layer is determined by a number of controls. First is the overall layer weight, which can also have a noise function applied to it.

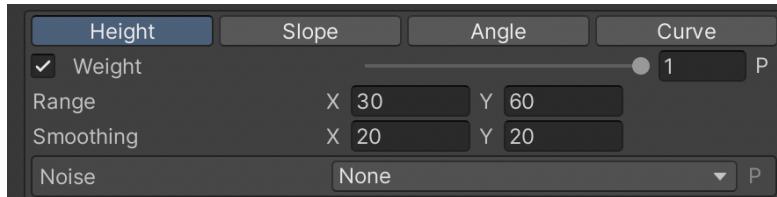
Understanding Noise:



Noise options appear in many places in MicroVerse. You can select the type of noise - Simple, FBM, Worley, and Texture. Next to the noise type is a "P" preview button, which will show

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you what the noise looks like on the terrain in red. For procedural noises, you can use the frequency to change the size of the noise pattern, amplitude to control the contrast, offset to reposition the noise, and balance to change the center point of the noise, adjusting it towards white or black. Note that a negative amplitude will invert the noise. When set to texture mode, you can supply your own texture and set scale and offset instead.



Filters are a great way to place textures contextually based on the height, slope, angle, or curvature of the terrain before it. Like noise, there is a preview button to show the effect on that particular filter (in blue). Each filter has range and smoothing parameters. For instance, in the example above the texture is going to show from 30 units above 0 until 60 units above 0 at full opacity, and will fade in and out over 20 units on either side. So at 10 units this texture will not show up and will fade in fully by 30 units, then begin to fade out at 60 units until finally being completely faded at 80 meters.

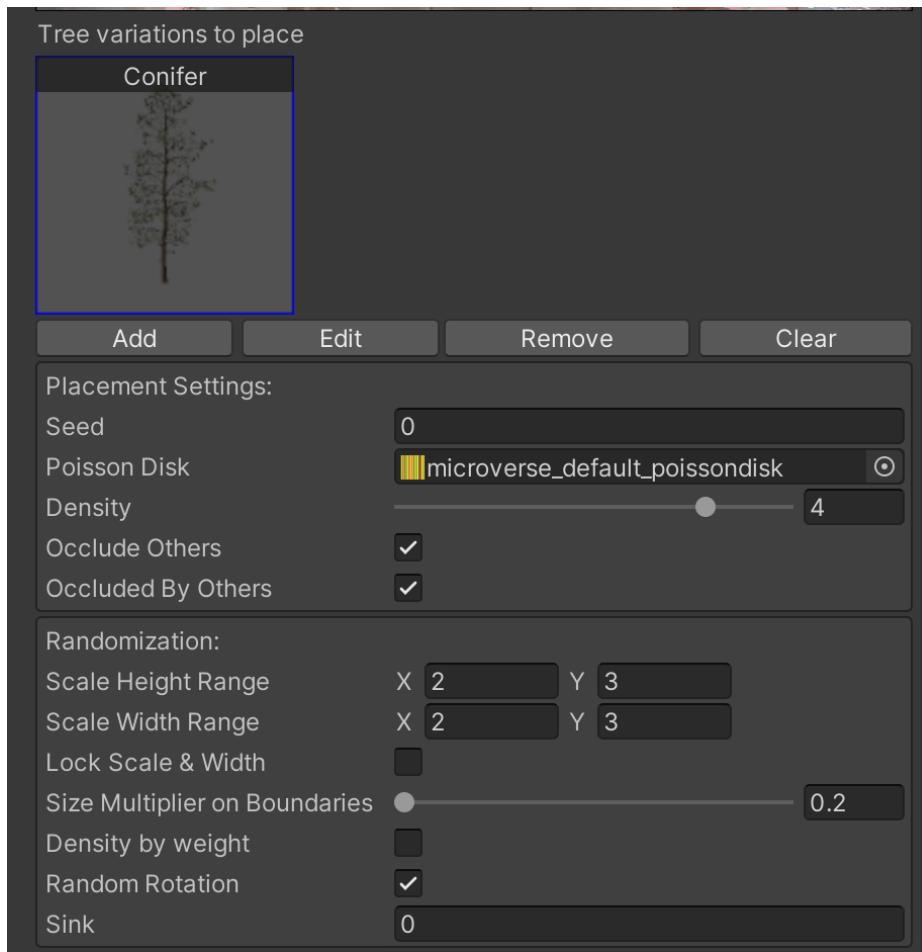
Slope allows you to texture based on the slope of the terrain, while angle is based on the facing. Curvature is based on the concavity or convexity of the terrain.

Finally, a noise is also available on each filter as well. Note that by default the texture stamps works across the full scene, but can be restricted to certain areas with the falloff system.

Tree Stamps

(Requires Vegetation Module to be installed)

Tree Stamps allow you to place vegetation across the terrain. Note that you do not need to setup tree's from Unity's terrain interface, you can add them directly to the tree stamp and it will add them to the terrains which use them automatically. Within a given tree stamp, you can have multiple vegetation prefabs. Think of each terrain stamp as one "system" with variations within it.

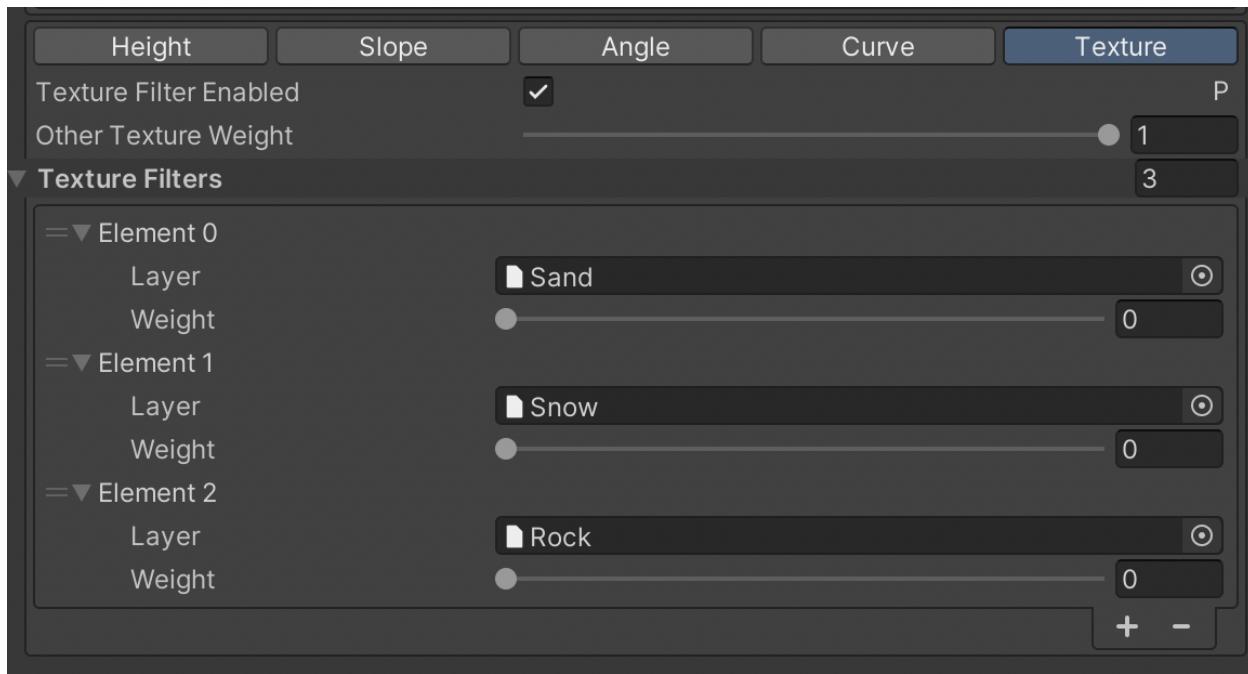


A seed is available which will change the randomization seed for everything within the stamp. A poisson disk image is used to vary the placement of objects without letting them overlap, but it's unlikely you'll ever need to change this image. The density slider controls how many vegetation objects should be placed.

MicroVerse has a primitive occlusion system for object placement. You can have these objects write into that buffer, or be occluded by things in it. These settings are all global to the stamp.

Below these settings are per-object settings for each prefab in the system. These let you vary the scale of instances, or have the weight of the stamp affect the size of the objects or density as you approach the fading edge of an area. Finally you can set a sink factor which pulls the object downwards into the ground.

Finally, all of the falloff and filters described earlier are available, along with a new filter type which allows you to filter based on the textures on the terrain.



The Texture filter allows you to filter things based on which textures are on the terrain. In this example, the other texture weight is set to 1, and the listed layers are set to 0. This means that tree's will appear on any terrain layer except sand, snow, and rock. If you wanted the tree's to only appear on Sand, you would set the Other Texture Weight to 0, and set the sand to 1.

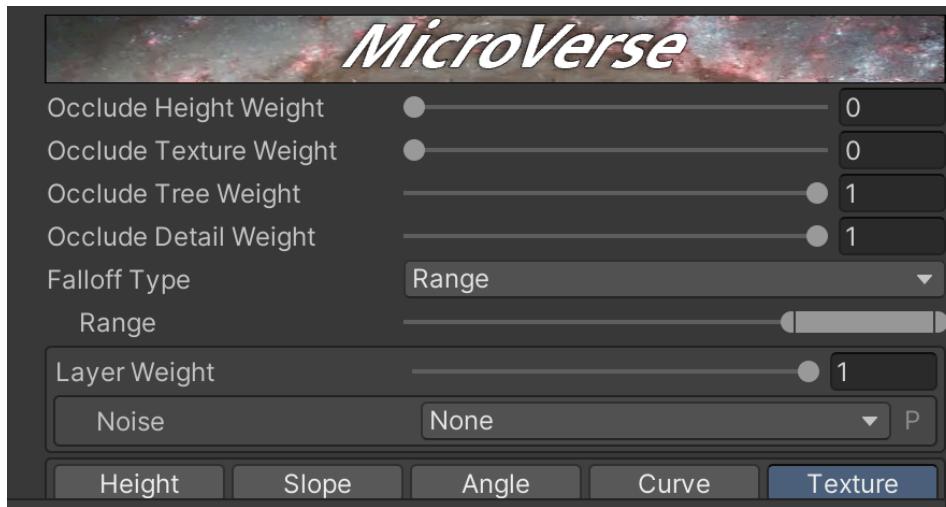
Details Stamp

(Requires Vegetation Module to be installed)

The details stamp is similar to the tree stamp, but for Unity's detail system. Due to the way Unity's detail system works, only a single detail object is used per stamp. Also note that by default Unity's detail system is extremely GPU crushingly dense, and usually has to be reduced on the terrains to 0.1 or less. The controls here match Unity's detail system when adding new detail objects, and the rest of the controls will be familiar from the earlier documentation.

Occlusion Stamp

The occlusion stamp can be used to prevent things from appearing in a given area. Essentially, it writes into the occlusion mask and blocks future stamps from adding their effect to an area.



You can set the amount of occlusion for each type of stamp effect - for instance, this stamp is preventing tree's and details from appearing in a circular area (falloff).

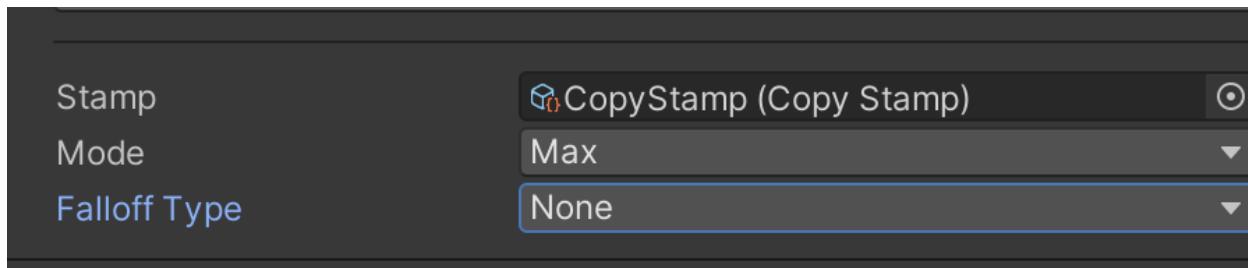
Copy/Paste Stamp

To understand how this stamp works, you'll need to understand a bit about how MicroVerse works internally. The stamps previously discussed start from a blank terrain and build everything up from scratch. But perhaps you want to customize an area with Unity's paint tools, or copy some area that you really like? The copy paste stamp can do this, and is an extremely powerful way to use traditional terrain tools in a non-destructive way. But if you just open up the Unity paint tools and paint, when MicroVerse recomputes the world from scratch it will erase those changes as it will start from a blank terrain and rebuild its changes based on the stamps it has.

So what the Copy/Paste stamp does is allow you to create a stamp from whatever is on the terrain in its falloff area, and then re-apply that data to the terrain in the procedural process. You can then move that area around, place it multiple times, prefab it with any objects parented to it, and even apply additional stamps on top of it.



At the top are settings to set what you want to copy or apply, along with a Create Copy Object button. Once pressed, it will ask you to save a stamp object, which is where it will store the data.



Once created, you can set the height mode for the stamp and falloff settings. You can then freely move the stamp around and the data will follow.

Note that it's very easy to trigger a refresh of MicroVerse - enable/disable a stamp object, or otherwise changing a value in the system, will trigger it to rebuild the world from scratch. So if you are using the Copy/Paste stamp to do extensive painting/modification of the world manually, it is best to save the scene and disable the MicroVerse component or game object while you do these changes, then make the copy and re-enable it. This will prevent an accidental refresh of MicroVerse from destroying your change.

Working with an existing terrain

MicroVerse rebuilds the world from the beginning each time a change is made. This is how it achieves its non destructive workflow. But that beginning is assumed to be a blank terrain. However, sometimes you might want to work with an existing terrain and add stamps on top. This can be achieved by use of the Copy/Paste stamp, but requires some care in its approach. To make this easier, there is a menu item which will perform this setup for you.

First, **back up your terrain**, as doing this wrong can easily white the data from the terrain data object.

Select the “GameObject/MicroVerse/Create MicroVerse for existing Terrains” option. It will warn you to backup your terrains first. After confirming, a MicroVerse game object will be created, and all terrains in the scene will be reparented to be under it. For each terrain, it will create a Copy/Paste stamp which is sized and placed exactly over the terrain, and use it to capture the state of the terrain as the starting point for all Microverse work. It will save the data about the stamp next to your terrain data on disk. This data allows MicroVerse to reconstruct the terrain to this initial starting state at the beginning of its generation of the world, so do not delete it.

Splines

(Requires Spline Module to be installed)

If the Spline package is installed, several new features are available:

- The ability to create spline based paths, which affect the height of texturing of the terrain, and can clear tree's and details from their path.
- The ability to create areas with splines, which can be used with the falloff system. This lets you create arbitrarily, custom shaped biomes, and adjust their positioning and shape in realtime.

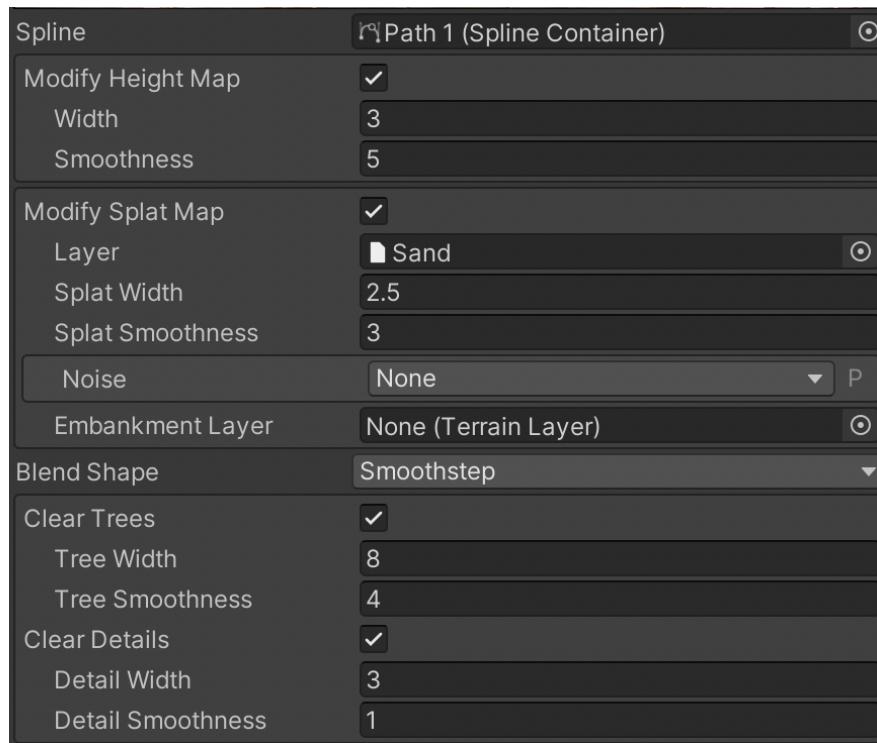
Installing the Spline package

If you are in Unity 2022 or greater, you can install the spline package from the package manager.

However, the spline package is not available for 2021, so MicroVerse-Splines includes a backported version in the package. To install it, unzip the SplinesForUnity2021.zip file somewhere on your machine (somewhere you won't delete it by mistake). Then open the package manager and press the + button in the top left corner of the window and select "Add package from local file". Navigate to where you unzipped the package and select the package file inside the main folder.

Creating a spline path

The Spline module uses Unity's Spline system, which has additional features for placing objects along splines, generating meshes, etc. To create a path, create a new spline from the GameObject/Spline/Draw Spline Tool and create a path. Then add the SplinePath component to the spline, and make sure the game objects are under the MicroVerse game object.

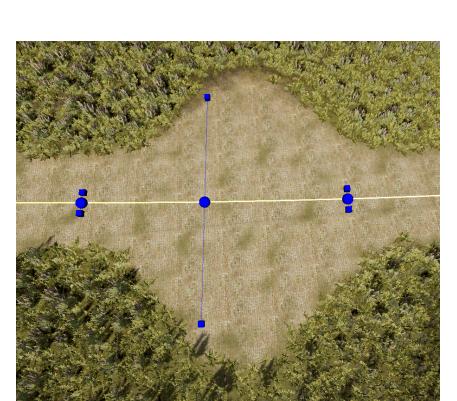


Set the spline reference to the spline you created. You can have the spline modify the heightmap or splat map, and control the area around the spline (width) and falloff (smoothness) of the effect. The texturing area lets you choose a layer to paint where the spline is with its own width/smoothness setting, and an embankment texture for the sides of the trail. You can also apply noise to the texturing to create a more broken look to the trail.

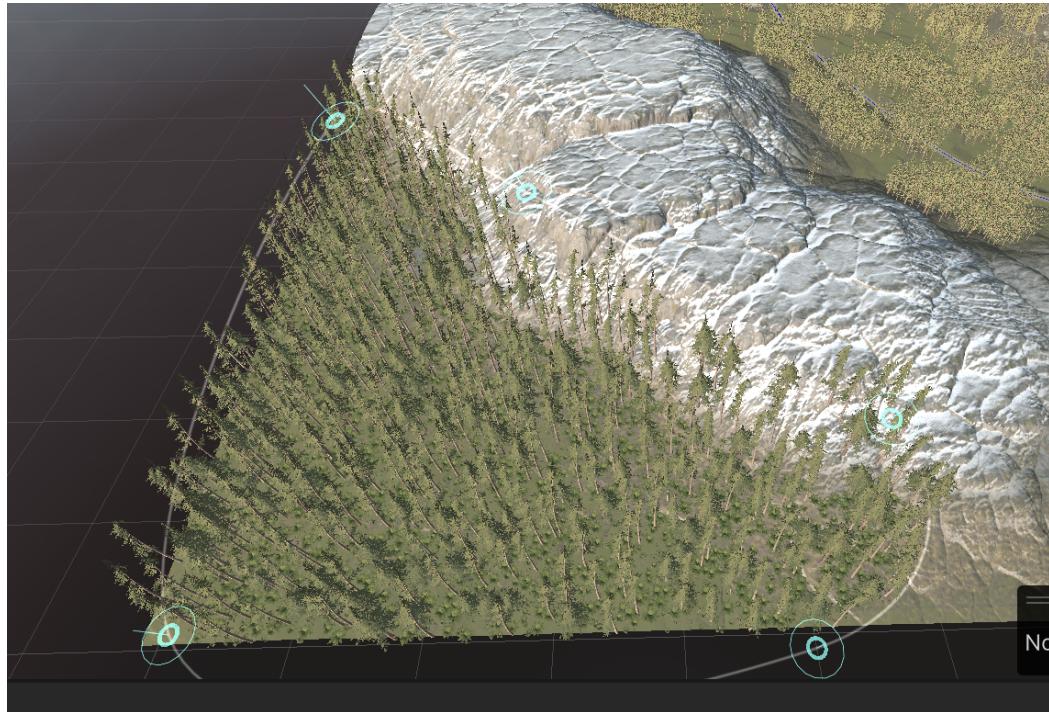
You can also specify width/smoothness for clearing trees and details from the path.

Spline Widths

Splines themselves can have width added to them, allowing you to adjust the width along points of the spline. However, though MicroVerse supports having multiple splines in one spline container correctly, Unity's tools for working with multiple splines are incomplete, and custom spline data (like width) cannot be added to a spline. This means width is only supported on the first spline.

	<p>When a Spline is selected, you can use the first control in the overlay toolbar to select spline mode, and the last one to adjust the width of the spline. Once selected, you can double click anywhere in the spline to create a new width control point.</p>		<p>You can widen the spline by using the handles on either side of the width control points, or move the control points along the spline. Right clicking on a width control point removes the width control point.</p> <p>At the bottom of the SplinePath inspector, there's an option to change the interpolation on the spline widths. The image to the left is set to smoothstep.</p>
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Spline Areas

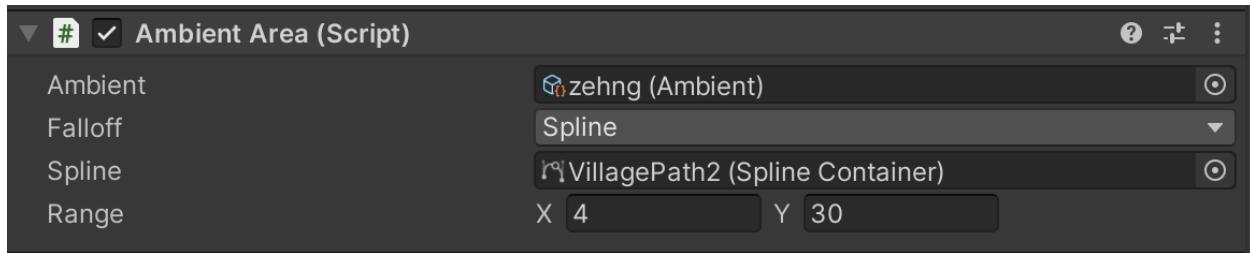


To create a spline area, create a new, closed spline around an area, and add the Spline Area component to it. Add any stamps below it and change their falloff to "Spline Area", and assign the spline area to them. Rather than using the stamps falloff, any stamps assigned to the area will use the spline area instead. They will also have a falloff property that lets you control the weight around the edge of the spline.

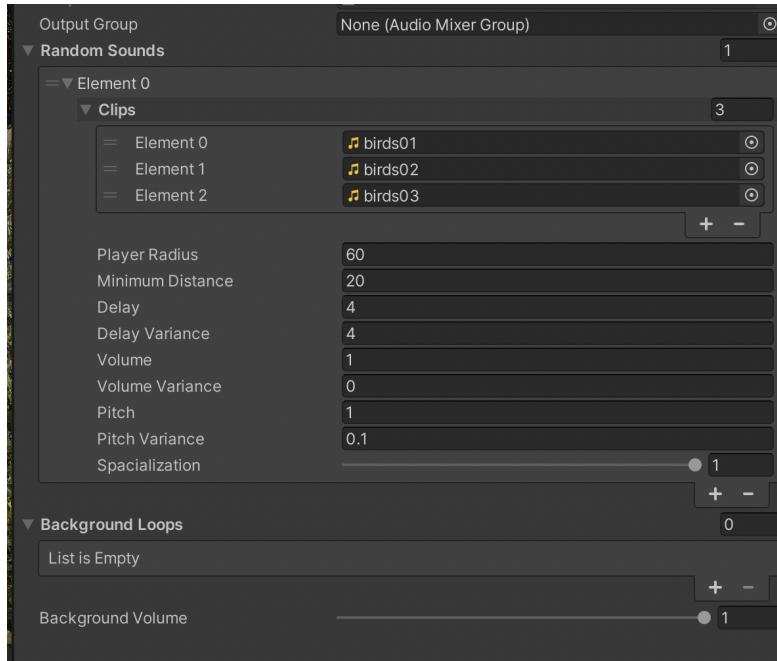
Ambient Area

If you have the MicroVerse - Ambiance module installed, you can place areas of ambient sound effects and music, and use similar falloff's to constrain them to specific areas of the world.

Each ambient area has a reference to an Ambient scriptable object, which can be created from the right click menu.



Here we see audio being constrained to 4 unity from the spline, with a 30 meter falloff area.



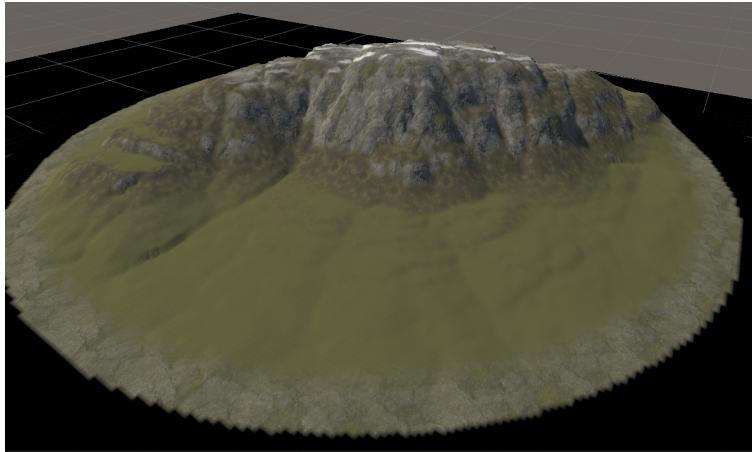
Here we see an example of the ambient scriptable object. Many different areas can reference a single ambient scriptable object, but only one of each instance will play regardless of how many areas use it. In this example, we will trigger one of three bird sounds every few

seconds. They will be placed a minimum of 20 meters from the camera, and a maximum of 60, specializing them around the camera. Each time they play, they will have a small amount of pitch variance applied.

A looping background track can also be provided, used as a noise floor or musical soundtrack. Note that you can use as many areas to define your areas, but you can also have multiple areas overlapping each bringing in different ambient's to play.

The Content Browser

MicroVerse has a content browser which you can open from the Windows/MicroVerse/Content Browser menu. From the browser you can access pre-existing stamps designed to work with MicroVerse, as well as download new content packs which provide you with more content. These assets may combine multiple stamps to create more complex effects, and downloaded packages may install additional content in the browser to speed up your workflow. For instance, a single stamp might contain multiple texture layers, which texture your world in a specific style. Some example content has been included.



For instance, here I dragged a single height stamp and the 'Alpine' texture stamp into the scene. These can both be found in the MicroVerse-Examples packs. The alpine texturing stamp is a prefab that contains multiple texture layers, applying rock, grass, dirt, and snow to the terrain. By default, alpine is using a radial falloff, but you can easily change this to work globally across your terrain or to use a spline based falloff, for instance.

This is a far more convenient way to access content setup for MicroVerse than the Unity Asset folder structure because all of the content gets organized by type in one place, instead of spread across a file system. And while this system is primarily designed for asset store publishers to make it easier to use their content in MicroVerse, it can also be used by teams to organize common presets into quickly accessible stamps.

The browser also allows content publishers to link to external content and provide an image to advertise that content from within the browser. These show up as additional packs in the content browser with an image and download link instead of the actual content. If you are an asset store publisher and interested in providing this type of content for your users, please contact us so we can feature you right in the content browser.

Falloff Override Component

The falloff override component is a useful component when building collections of stamps for reuse that might want to have a single place to adjust their falloff. When added to the top of a hierarchy of stamps, all stamps below it will use these falloff settings.



MicroSplat Integration

(Requires MicroSplat to be installed)

MicroSplat, the best terrain shader for Unity, is well integrated into MicroVerse. By default MicroVerse manages what textures are on the terrain based on what stamps are in use, and will freely add or remove terrain layers as needed. And what textures are needed for each terrain can be different. However, this presents a problem for Texture Array based shaders like MicroSplat, which need all the textures in the same order and need to repack the arrays when textures are added or removed.

So when using MicroSplat, whenever new textures are added via a stamp, MicroVerse will show a warning and ask you if it can add the new texture layer and repack the arrays. It also has several controls on the main MicroVerse component to convert the terrain to MicroSplat, remove any unused textures from the arrays, or add any missing ones.

For other array based shaders, there is an option to keep all terrain layers the same across all terrains.

To convert your terrain's texturing to MicroSplat, you can simply press the button on the MicroVerse component, or assign the texture array config to it if you have gone through the traditional setup.

Demos

Each package contains its own demo scene, but if you own MicroVerse, MicroVerse-Vegetation, and MicroVerse-Splines, there's a demo with all three in action at:

<https://github.com/JDB-Tech-INC/MicroVerse-Demo>

This was excluded from the collection download to save space, as it adds another 500mb to the package size.

Common Issues

MicroVerse attempts to be very sneaky about when it sync's back to Unity terrain, as this can introduce random pauses into the workflow. However, Unity terrains uses some of the CPU side data to do things like set LOD levels, cull terrain, or move detail objects to the ground - and when things get far enough out of sync you might notice rendering errors and clipping of the terrain. However, you can fix these by pressing the "Sync Back To Terrain" button on the MicroVerse component, or by simply saving the scene with ctrl-s. Usually these issues are minor, and will fix themselves once MicroVerse finds a moment to sync back to the terrain.

Sync to Terrain (Save)

Tips

MicroVerse is built on a number of reusable concepts, designed to work across multiple terrains, and intrinsically handles complex problems like biome and terrain resource management for you. You can integrate in traditional workflows like the terrain painting system via the copy/paste stamp, while giving them new features like being able to move or replicate your work. Everything happens in real time, with no baking. With some understanding of the system, you get a completely non-destructive workflow that lets you rapidly take an environment from concept through production.

Prefabs:

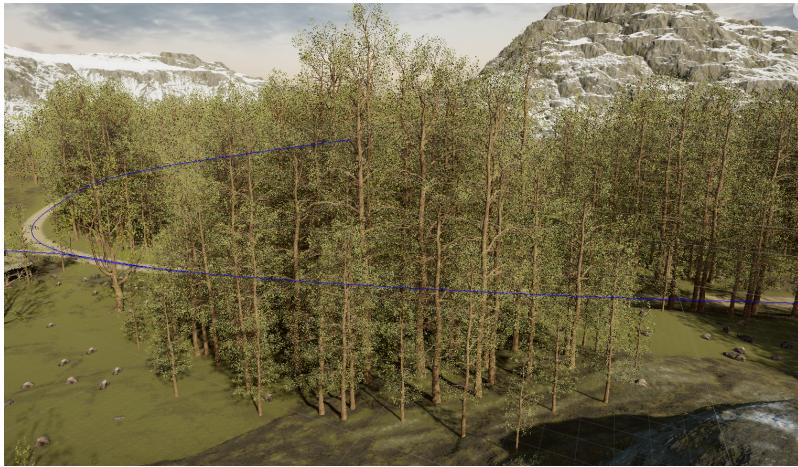
Stamps contain all the data they need and thus can be turned into prefabs and copied from one terrain to another. For instance, you could prefab a bunch of texture layers as a preset and drop it onto a terrain to quickly texture it. Or create a spline based area for it and drop it into that area to texture it. Or you could prefab a small village, complete with painted texturing, and drop it onto another terrain and set it into a mountain with the mountains terrain adapting around it. Since everything the stamp needs is included with the stamp, it will carry the textures and vegetation with it, and any other objects you throw in there.

Note that some of Unity's terrain shaders have a hard limit of 8 textures per terrain, and that it's really easy to go over that. With MicroSplat, that limit is raised to 32 in all render pipelines.

Trees

Things in nature are generally not just randomly scattered over an area, but rather contextually end up in certain places. Filtering is, in general, a powerful tool to create context in placement - using a texture filter, for instance, piggybacks off of the previous context aware patterns created in texturing.

However, tree's in particular tend to grow in clusters and clumps until the forest grows in. This can be easily simulated in MicroVerse, and produces much more natural looking tree areas.

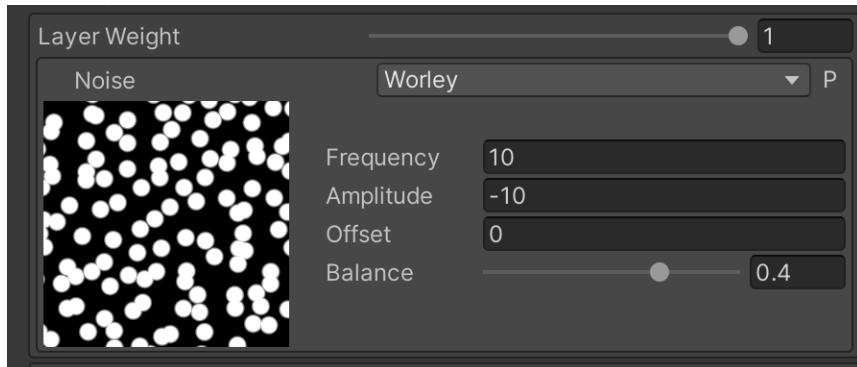


For instance, here we see a cluster of trees which look like they grew up around an older tree.

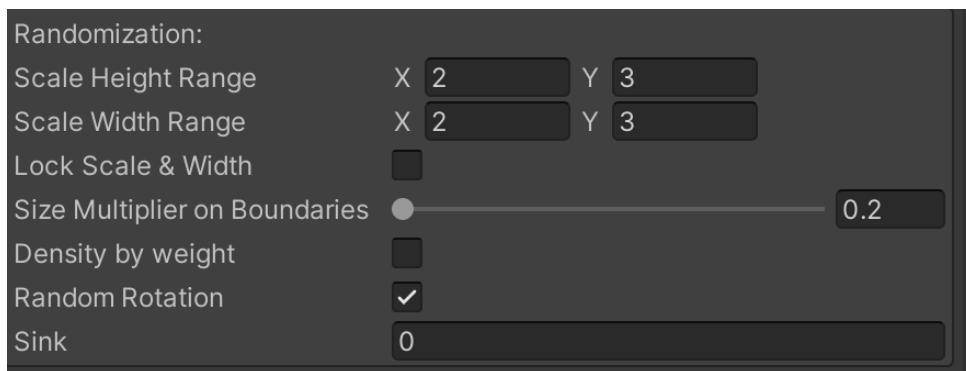
Now look at it from the top:



Notice how multiple clumps create the effect of natural clusters forming, with meadows between. This creates a very compelling look which is fun to explore.



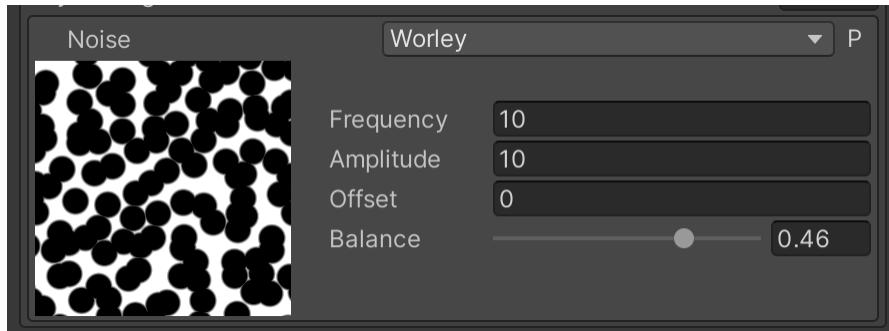
The way this effect is created is by creating a noise pattern for where tree's appear. In this case I'm using worley noise, which when pushed to high amplitudes and balance settings, creates a set of dots. Each dot represents our cluster of trees, with the areas between them being our meadows.



The other trick here is the use of the “Size Multiplier on boundaries” slider. At 0.2, this means that tree's will scale down 20% as they are weighted low (this translates to the black areas of the noise).

With this combo, we can create clusters of individual trees that are tallest in the center and scale down as they get to the edge of the clusters.

But what about the meadows? How do we populate them?



By simply inverting our noise amplitude, we create a filter for the meadows, allowing us to place separate objects in those areas. For instance, we could have flowers that only grow in the meadows.

Area pads:

If you want to flatten an area of terrain around a house or a bunch of buildings, you can create a height stamp with no stamp assigned and parent your house to it - the terrain will rise up to meet this stamp, conforming around it based on its falloff. You could also add an occlusion stamp to clear the tree's and details from the area. The terrain will conform to the shape and height of the stamp, acting as a pad to build your scene off of. You can then move that area around, and the terrain will modify itself to conform around it.

Trees along a spline

Spline areas are primarily used to shape areas, but what if you want to place things along a spline? You could use Unity's `SplineInstantiate` script to do that, but it lacks ground collision, and produces game objects instead of using the tree system. You could have a spline area around the spline path, but then editing is clunky.

However, you can have a non-closed spline work as a spline area too. However, since the falloff goes into the spline area, it's always infinitely thin. But, on Spline Area there is a "Width Boost" value. Setting this to, say, 4, will make the spline 4 units thicker than the spline defines it as. You can then use the spline area falloff for any stamp to do things like spawn tree's along a spline.



A Tree Stamp is constrained to a spline with a spline area falloff. The Spline path occludes the tree's in the path area.

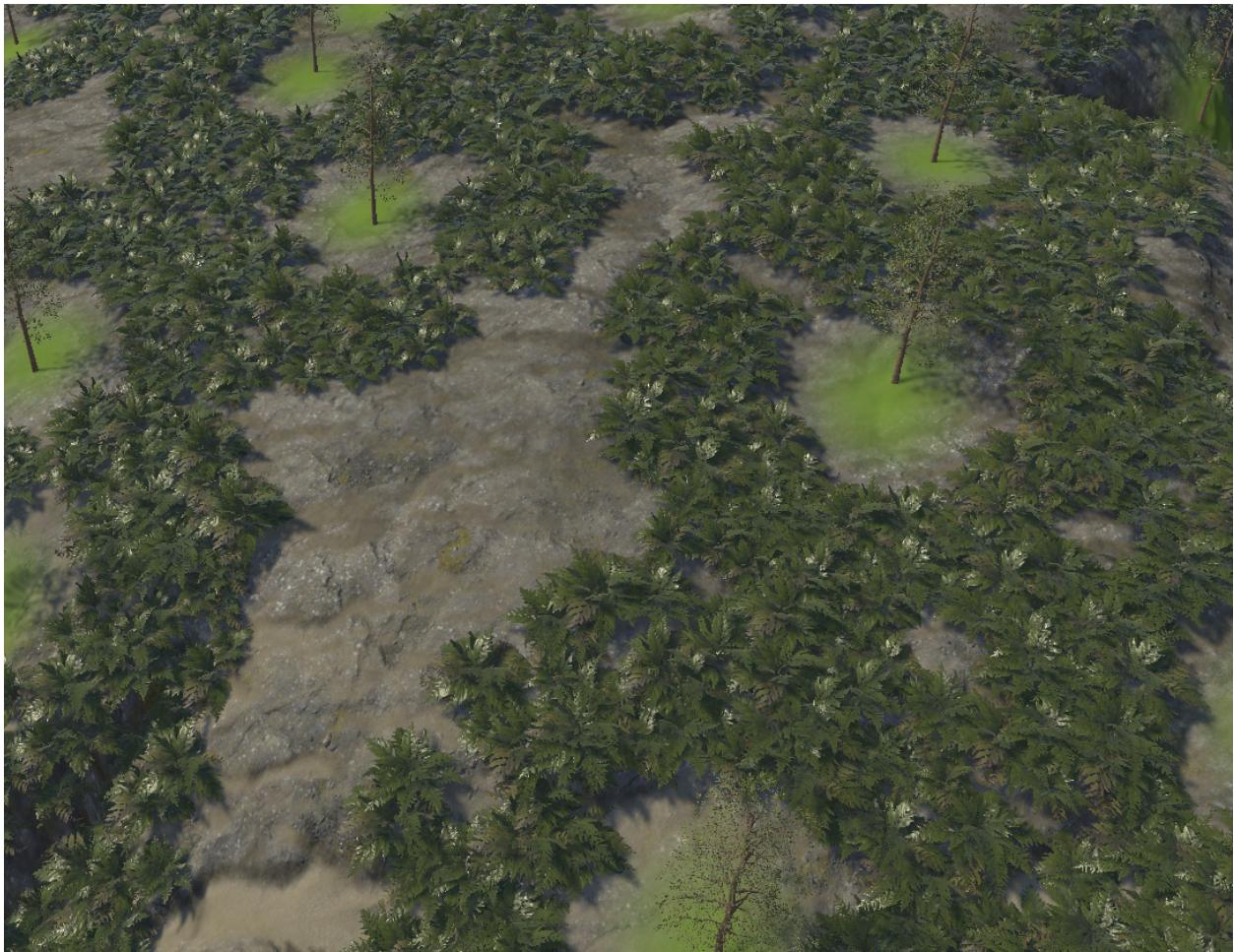
Trees distance fields

Tree stamps can generate a distance field, allowing it to perform lots of different effects.



For instance, when a tree gets large enough its roots push up the ground around it. The Height Mod Width and Amount properties can create this effect. You can also modify the texture around the tree to blend in variations of a texture.

These distance fields are then combined as each tree stamp is processed, allowing for future stamps to perform filtering based on how close they are to existing trees.



Here we are creating ferns with a tree stamp, with a minimum and maximum distance from the tree's which came before it. This creates a ring of ferns around each tree. The terrain also has a bright green texture around the tree with a subtle bump of height as well. While this example is extreme to show the idea, it can be an alternative to using negative noise and instead spawning each stamp with restrictions based on the placement of the last one.

Texture based noise and falloffs

Most people will reach for procedural noises and falloffs, but using a texture to define these can provide a lot of benefits, by providing for different signatures of noise and rougher falloffs than simple procedural shapes.

Importing external Splat Maps

If you have a splat map you want to import and use, you can do this by assigning it as the falloff on a texture stamp. Each texture stamp can map one texture layer onto the terrain, so to do a 4 channel splat map you would need to create 4 texture stamps, each pulling from one channel and assigning it one terrain layer. You could pair this with a height stamp to stamp externally created content from programs like world creator onto your terrain.

Runtime:

By default MicroVerse components are stripped from the build and play mode. This means that there is no runtime code or data, and no performance cost. However, you can delete the SceneBuildStripping.cs file and everything will get included into the build and continue to operate in play mode. Note however that this is a very expensive system to try to use at runtime, and IMO only viable as some kind of level builder. You will also want to manage things like sync back to the unity terrain, saving, etc. In general this is an unsupported workflow, and the system can consume a lot of GPU memory, but you could make a pretty amazing level editor in your game with it.

Editor Performance

Ironically, the largest cost in the system is usually not from building the terrain, it's from sending that data back to Unity. MicroVerse jumps through hoops to avoid the Terrain API whenever it can, but ultimately has to sync data back to it eventually. MicroVerse automatically culls stamps which have no effect on a particular terrain, but rebuilds the full world every time it updates. As such, using more but smaller terrains will usually help editing speed. Lowering resolution of terrain height maps and alpha maps will also help. And if you ever want to upres your work you can simply change the resolutions on the terrain and adjust a property to force MicroVerse to rebuild the world from scratch.

How MicroVerse internally processes data

It can be useful to understand how MicroVerse processes data. Essentially all height map data is generated, then texturing, then vegetation, then details. This is because each of these passes relies on the result of the previous data for filtering and occlusion. In each of those

passes, the data is ordered based on the order of objects in the hierarchy. So if you want an occlusion stamp to prevent vegetation in an area, you should place it before the vegetation stamp in the hierarchy.

Stupid Unity stuff

Unity's terrain system is really old, with a terrible API that they don't seem to want to fix. It also lacks many practical features which would make using it easier. One such example is detail rendering, which has a distance setting on the terrain. At whatever distance this is set, whole blocks of details will pop in and out of the scene, which is incredibly distracting. So what most shader authors do is fade the detail objects in the shader before that distance is reached. However, this means you usually need to adjust the shader and the terrain's detail rendering distance to work in conjunction, which may or may not be exposed by the shader you are using in the material. Ideally, if we could fix the terrain system, this would be published into a global shader variable so the user doesn't have to align all of this data correctly - but if you want to render details further than the default you will have to set those distances both on the terrain and every material you use for details.

Also, Unity's detail system does not support LODs, while many asset store based vegetation rendering solutions do (such as Vegetation Studio and Nature Renderer).