



Drop-In Waterfall — Realistic URP System

Documentation · v1.0.0 · Havoila Studio

Havoila Studio · Version 1.0.0 · Unity 2022.3 LTS and newer · Universal Render Pipeline 14 and newer

Drop-In Waterfall combines a falling-water column with an irregular, animated outline, fake self-shadowing, mist, spray, drips and a transparent river. The effect is designed for desktop, mobile and XR projects using URP. Its shaders require no camera depth or opaque texture and use no direct lighting; the river can sample Unity reflection probes.

The effect is authored with one component, **Waterfall**. The editor bakes that component into ordinary Unity objects: a few static meshes, Shuriken particle systems and one small data texture. Nothing runs in script at runtime.

1. Key features

- **Falling-water column.** Ribbons follow the real ballistic path of the water. Streak textures are sampled at each water parcel's "birth time", so the streaks accelerate and stretch with gravity without any simulation.
- **Irregular, living outline.** Bulges, necks and a sideways wobble travel down with the water. They are animated in the vertex shader.
- **Fake self-shadowing.** Thick masses of water block the sky and show as darker grey patches and surges that travel down the column.
- **Volume from particles.** Water clumps, column spray, column mist, a mist blast along the pool, slowly rising mist and impact spray.
- **Mist tubes.** Animated mist wrapped around the foot of the waterfall. The walls fade where they are seen edge-on, so the mist reads as a soft volume from every side.
- **Works from any viewpoint.** Nothing is oriented towards a camera or a viewer position: walk or fly all around the waterfall.
- **Drips.** Drip sources along the rock, each with fine, streaked drops and an optional GPU-only rain-curtain ribbon.
- **River and plunge pool.** Transparency, depth colour, flow-mapped ripples and foam come from a one-time top-down bake, so there is no depth texture at runtime. Three bake modes cover a flat pool, any ground mesh or terrain, and a vertex-coloured photogrammetry scan.
- **Artist-friendly Inspector.** Instant section toggles, inline materials, sliders with tooltips, live rebuild and slow-motion Scene preview.
- **Scene view handles** for the lip, exit velocity, widths, drip sources, pool, river region and mist tubes.
- **Create menu** with ready-made layouts (6 m, 15 m and 35 m drops) and a ready-to-use prefab.
- **XR rendering.** Single-pass instanced and multiview variants, premultiplied alpha, fixed effect queues, and water-height and near-camera fades.

2. Requirements and compatibility

Unity	2022.3 LTS or newer. Tested with 2022.3.62f3 and 6000.6.0f1.
Render pipeline	Universal Render Pipeline 14 (Unity 2022.3) or newer, tested with URP 14.0.12 and 17.6. Built-in RP and HDRP are not supported.
Target use	Desktop, mobile and XR. Shaders include single-pass instanced and multiview variants. Validate graphics API, stereo rendering and performance on your target device.
URP settings	Nothing special: the depth texture and opaque texture can stay off .
Effect dependencies	URP. The included demo camera rig also uses Unity XR Legacy Input Helpers; this is not needed to use the waterfall prefab or builder in your own scene.
Enter Play Mode Options	Supports disabled Domain Reload and Scene Reload. Checked through two consecutive play/stop cycles in Unity 6000.6.0f1.

3. Package contents

```
HavoilaStudio/DropInWaterfall/  
  Runtime/      Data component and Inspector attributes  
  Editor/       Builder, river bake, Inspector, handles and preview  
  Shaders/      Five effect/helper shaders and shared HLSL  
  Materials/     Nine default effect materials  
  Textures/     Six effect textures  
  Prefabs/      Waterfall_Medium and its generated assets  
  Demo/         Example scene, environment and generated FX  
  Documentation/ Markdown and PDF guide
```

4. Quick start

Open the demo

1. Open `Demo/DropInWaterfall_Demo.unity` inside the package folder.
2. Select the object with the **Waterfall** component. The Inspector shows every part of the effect.
3. Press Play, or tick **Live preview** in the Inspector to animate the effect in the Scene view.

The effect can be viewed from any side. To use it without an XR camera setup, follow either of the workflows below in your own URP scene.

Create your own waterfall

1. Move the Scene view so its pivot is where the plunge pool should be.
2. Choose **Tools > Havoila Studio > Drop-In Waterfall > Create Waterfall > Small / Medium / Tall**.
3. A complete waterfall is created, and its materials are copied into its own folder.
4. Use the Scene handles (Inspector toolbar: **Column, Drips, Pool, Mist**) to fit it to your cliff.
5. Press **Bake river** once the pool and river are in place.

Or drop the prefab

Drag `Prefabs/Waterfall_Medium.prefab` into your scene. Select it and press **Rebuild all** if you change anything. Several instances share the prefab's materials: use **General > Make materials unique** to tune one of them on its own.

5. How it works

Part	What is built	Cost
Column, sheath, drip curtains	Curved ribbons merged into one mesh per material; vertices follow a ballistic path.	Geometry depends on ribbon count and resolution
Mist tubes	Open, flared tubes merged into one mesh, with animated noise and soft fades	Geometry depends on tube count and resolution
River	Baked surface mesh and <code>T_RiverData</code> storing depth, foam and flow	5 base texture fetches plus optional probe samples
Particles	Shuriken systems for clumps, mist, spray and each drip source	CPU: live particle count; GPU: overdraw

- **Coordinates.** Every position in the component is in the **local space of the waterfall GameObject**: move the GameObject to move the whole waterfall. Rotate it around **Y only** and keep a **scale of 1**, because gravity is always world-down. Rebuild after rotating.
- **Orientation.** Everything is oriented from the main column's **exit direction** (out from the cliff), never towards a camera. The ribbons bulge out along it; the lip, the drip edges and the emitters run across it. The waterfall therefore looks right from any viewpoint.
- **Height fades instead of soft particles.** The particle and mist shaders fade out above the water surface, so they never cut hard into the pool. The builder sends the water height to the materials automatically, and again whenever the waterfall is moved.

6. Inspector reference

The header toolbar contains:

- **Live rebuild.** Value changes rebuild the effect automatically. The river bake is excluded because it takes a few seconds.
- **Live preview.** Animates the particles and shaders in the Scene view without entering Play mode.
- **Rebuild / Rebuild all.** *Rebuild all* also re-bakes the river.
- **Scene handles.** Choose which group of handles is shown in the Scene view.
- **All ON / All OFF** and **Expand all / Collapse all.**

Every section has an **ON/OFF toggle**. Toggling hides or shows the generated objects instantly, with no rebuild. **Material blocks** inside the sections edit the material asset directly: the change is instant and is shared by every object using that material. Hover any field for a tooltip.

Section	Controls
General	Preview speed (editor slow motion), output folder, Make materials unique , Save as prefab
Waterfall column	Lip, exit direction and speed, bottom height, widths, offsets, arc, resolution, opacity, fade-in, seed, and the column material (colours, body, streak motion, irregular shape, self-shadowing)
Column sheath	The other ribbons (a soft halo around the column) and their material
Column clumps	Rate, shadow tint (random darker clumps) and the clump material
Column spray	Rate, droplet size, streak length and the spray material (shared with Impact spray)
Column mist / Impact mist blast / Impact rising mist	Rate, size, growth, life time, speed, area, spread, drag, lift, opacity, spin, max particles, and the mist material (shared by the three)
Impact spray	Rate, size, growth, streak length, life time, speed, area, cone angle, gravity, opacity, max particles
Mist tubes	The tube list (centre, bottom and top radius, height, tint, seed, speed) and the mist material (billow size, rise and swirl speed, shape, edge-on fade, fades)
Drips	The drip sources (position, width, bottom, rate, curtain opacity), the drop settings shared by all sources (rate multiplier, size, stretch, life time, speed, spread, gravity, opacity, cap), the drop material, and the curtains (show / hide, curtain material)
River	Bake mode and settings, plunge pool, flow, reflection probes, reflection smoothness/strength/tint, the optional river-bed clamp
Advanced	The raw ribbon list (add or remove ribbons), the main column index, the <i>Build particles</i> option

7. Scene handles

Group	Handles
Column	Lip (moves every ribbon), exit velocity (a sphere 1 s ahead of the lip: direction and speed), top and bottom width , bottom height . The trajectories of every ribbon are drawn.
Drips	Position, width and bottom of each drip source
Pool	Plunge pool centre and radius, river bake region (box), water level. Press Bake river afterwards.
Mist	Centre, bottom radius, top radius and height of each mist tube

While you drag a handle, only the ribbons are rebuilt, so dragging stays fast. The full rebuild runs when you release the mouse. Every handle edit can be undone.

8. River bake

The river is baked once, from above, over the **River region** box. X runs downstream.

Mode	Use it for
Flat Rectangle	No ground needed. A rounded pool with an irregular shoreline fills the region at <i>Water level</i> . It is the default for new waterfalls.
Below Water Level	Any ground mesh (MeshFilter) and/or Terrain . The water is wherever the ground is below <i>Water level</i> and connected to the pool, and the real depth is measured.
Scan Colour	Vertex-coloured photogrammetry. Water is found from the scan colour (blue-grey or white) and its height, and the water level is measured along the river, never rising downstream.

The bake writes `T_RiverData.png` (R depth, G foam, BA flow) and `T_RiverHeight` into the output folder, and builds the `FX_River` surface mesh. The flow follows the geodesic distance from the pool through the water, so it turns with river bends and spreads radially in the pool. Foam comes from the impact, the rapids (fast and shallow water) and, in Scan Colour mode, bright white water in the scan.

Optional river-bed clamp. Assign the *Environment (Vertex Colour, River Bed)* shader to your ground and put that material in the River section. With **Bed Clamp** on, ground vertices inside the river are pushed just below the water surface. This hides scan spikes that poke through the water. It is a helper for vertex-coloured scans; with your own ground shader, simply keep the bed below the water.

9. Shaders

The waterfall, mist, particle and river shaders use premultiplied transparency, include stereo variants and do not respond to direct lights. Their render queues are:

- River: Transparent-50
- Mist: Transparent-10
- Column and particles: Transparent

The optional Environment helper is opaque and uses vertex colour. Environment materials in your own scene can use other shaders.

Shader	Notes
Column	4 fetches of one RGBA streak texture, plus 1 for self-shadowing. Vertex-animated outline.
Mist	3 fetches of one RGBA noise texture, seamless around the tubes. Edge-on, height and near-camera fades.
Particle	1 fetch (R alpha, G self-shading). Height and near-camera fades, adjustable additive amount.
River	5 base texture fetches: data, 2 ripple normals and 2 foam samples. Reflection probes add samples. Includes ripple distortion, smoothness, probe blending, box projection, Fresnel, depth absorption and shore fade.
Environment (Vertex Colour, River Bed)	Optional ground helper: unlit vertex colour, optional river-bed clamp.

River reflections. **River material** > **Reflection probes** is on by default. Place and bake a Unity Reflection Probe whose influence volume covers the water, or use a custom/realtime probe. Outside local probes, URP uses the scene's environment reflection. **Reflection smoothness** controls blur, **Reflection strength** controls the Fresnel contribution, and **Reflection tint** colours the reflected environment (white leaves it unchanged). Ripples distort the reflection automatically.

Enable **Reflection Probe Blending** and **Box Projection** on the active URP asset to use those features; box projection must also be enabled on the probe. Forward and Forward+ rendering are supported. Generated river renderers use **Blend Probes**; for an older generated waterfall, press **Rebuild** once to update that renderer setting. The included prefab is already configured.

Untick **Reflection probes** to use the original flat-colour reflection without probe texture samples. Baked or custom probes avoid realtime capture cost; probe sampling still adds GPU work, especially with blending. No camera depth or opaque texture is required.

The editor preview can slow the effect down with a global clock (`_HavoilaWaterfallTime` / `_HavoilaWaterfallTimeMode`). In builds the shaders always use `_Time`.

10. Performance

Cost depends on ribbon and tube resolution, river area and bake resolution, enabled emitters, particle caps, screen coverage and reflection settings. Mesh counts are not measured draw-call counts: use Unity's Profiler or Frame Debugger in your target configuration.

The effect uses six supplied PNG textures, plus per-waterfall baked data:

Texture	Source resolution	Purpose
T_WaterfallStreaks	256 x 1024	Falling-water streaks and self-shading
T_ParticleAtlas	1024 x 512	Particle shapes and shading
T_MistNoise	512 x 512	Mist tube noise
T_Foam	512 x 512	River foam
T_RiverNormal	512 x 512	Ripple normal map
T_Droplet	64 x 64	Fine drips and spray

River-data dimensions depend on the bake settings. Environment geometry, environment textures, lightmaps and reflection cubemaps have separate costs. Profile the effect in your own scene rather than treating an example scene as a fixed performance budget.

To save CPU or GPU on standalone VR:

- **Reduce particle CPU work.** Lower *Drip sources - particles > Rate Multiplier*, per-source rates or particle caps.
- **Reduce transparent overdraw.** Use fewer, smaller or shorter mist tubes and fewer mist particles.
- **Budget reflections.** Prefer baked or custom probes, lower cubemap resolution when appropriate, or untick **Reflection probes** on the river material. Realtime captures add rendering work beyond the river shader itself.
- Turn off the parts that are hidden in your view.
- Measure frame time on the target device at the intended resolution and refresh rate.

11. Multiple waterfalls, moving and prefabs

- Each waterfall saves its generated assets in its **output folder**. The default is `<Scene folder>/<Scene>_Waterfall/<GameObject name>`.
- Use **Make materials unique** when a scene has several waterfalls: the river data texture and the water height are stored in the materials.
- Moving a waterfall is safe: the water height of its materials follows. After a **rotation**, press **Rebuild** so the particle velocities follow.
- **Save as prefab** stores a copy of the built waterfall in its output folder.

12. Limitations

- The falling water is a set of curved ribbons, not a volume. Seen exactly along the lip, the column looks thinner, as a real waterfall does.
- There is **no direct lighting** on the effect: tune its colours to your scene. River reflections come from probes or a flat tint. There is no water interaction or collision.
- Transparent surfaces can still sort imperfectly when they overlap other transparent objects.
- Reflection probes provide cubemap reflections, not planar or screen-space reflections. A baked probe does not update when scene objects move.
- The river is a **static bake**: its shape, depth and flow do not change at runtime.
- The waterfall object must be rotated around Y only and keep a scale of 1.
- URP only.

13. Troubleshooting

- **I change a value and nothing happens.** Check that *Live rebuild* is ticked and that the section is ON. River settings need **Bake river**.
- **The particles are frozen in the Scene view.** Tick *Live preview*. Unity only simulates particles in edit mode while they are selected; the preview drives them for you.
- **Mist or particles are cut, or invisible near the water.** Rebuild or re-bake the river so the water height reaches the materials. Also check the *Fade above water* value of the material.
- **The river covers the banks.** Lower *Water tolerance*, raise the ground, or shrink the *River region* and bake again.
- **The river reflection is missing or flat.** Enable **Reflection probes** on the river material, bake a probe covering the river, and check its influence volume, tint and strength. Rebuild older generated rivers so their renderers use **Blend Probes**.
- **Materials are pink.** URP is not the active render pipeline.
- **Another waterfall changed too.** They share materials: use *Make materials unique*.

14. Support

Havoila Studio · support@havoila.com · havoila.com

Online documentation: havoila.com/assets/drop-in-waterfall/docs/

Please include your Unity and URP versions, the target platform and a screenshot of the Inspector.

15. Version history

- **1.0.0:** first release.