YOU MUST READ AND UNDERSTAND THESE WARNINGS BEFORE USING THE EMRIVER MODEL

The Emriver Em3 model is very heavy when filled with water and sediment. A collapse of the model supports could severely injure or kill a person. Be absolutely sure you understand how to use the supports.

Use only the supports provided with your model. Despite weight-bearing claims, no standard production sawhorse is strong enough to safely support the Em3 model. Sawhorses and folding tables can collapse under dynamic or side loading.

Check all hardware on the supports before each use to be sure they are secure.

When setting up the box, the supports must be laterally level and aligned. They must also be aligned with the proper support point underneath the box. Otherwise the box could warp or could collapse when loaded.

Never set up the box on a surface with a slope exceeding 8% (a 7-inch drop in 7 feet).

Never use more than 40 gal (151 L) of water in the model. Using more than the maximum amount of water and sediment could cause the box or supports to collapse.

Never use more than the provided 240 lb (109 kg) of sediment in the box, and do not place any heavy objects in the box.

Never allow people to sit or stand on or in the box. Never get underneath the loaded box.

Use only the pump and power supply provided with the box. Read the manual that accompanies the power supply and be certain to connect it to a properly grounded outlet. Always use the Ground Fault Circuit Interrupter (GFCI) provided with your model.

When using a 12-volt battery to power the model, always use the Emriver Battery Adapter provided by Little River Research & Design. Never bypass the fuses.

When powering the model with a 12-volt battery, be sure you understand the dangers associated with charging and using lead-acid batteries, and consider using safer spill-proof batteries.

The box should only be used for its intended purpose as stated herein.

If any part of the box or pumping system is damaged, if you have any doubts about the electrical or structural safety of the model, or if you do not understand these directions, do not use this model.

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Introduction

This manual describes the safe use and maintenance of your Emriver Em3 river process geomodel. It is very heavy when filled with modeling media and water, and could be dangerous if not properly supported, assembled, and operated.

You must read, understand, and abide by all the instructions and warnings in this manual to avoid damage to the model or personal injury. Updates to this manual and other support for the Emriver Em3 can be found at http://www.emriver.com or lrrd.blogspot.com. Please contact us for additional support if your question cannot be answered online.

Parts and Accessories Checklist

Emriver Em3 parts and accessories:	Other parts and supplies you may want to have on hand:
☐ Emriver Em3 box ☐ Modeling media in 8 buckets ☐ Emriver Use and Care Manual ☐ Standpipe ☐ Emriver supports ☐ Two 27-gallon reservoirs ☐ One-inch tubing with fittings for reservoir valves ☐ Pump and filter with tubing attached ☐ Clamp for pump tubing ☐ Sediment trap ☐ Emriver Crayfish Electronic Flow Controller ☐ Power supply ☐ GFCI-equipped outlet ☐ Hydraulic shapes ☐ Measuring tape ☐ Solid scoop ☐ Perforated scoop ☐ Riprap stones ☐ Simulated riparian vegetation ☐ Scrapers for moving media	☐ Paper towels and mop ☐ Shim materials ☐ Hand level ☐ Plastic buckets for sediment and water ☐ Garden hose ☐ Scraper/trowel ☐ Notebook ☐ Household bleach ☐ Small towels for drying hands ☐ Sieve ☐ Laser level (for use with Scientific/Academic Kit) ☐ 12-volt battery (for use with Emriver Battery Adapter) ☐ Battery charger (for use with Emriver Battery Adapter)

Accessories available for purchase from Little River Research & Design:	
☐ Alix Digital Flow Controller ☐ Emriver Battery Adapter *Outreach Kit:* ☐ Model tractors (bag of 6) ☐ Model people and canoe ☐ Opaque riprap ☐ Concentrated dye (blue) ☐ Concentrated dye (green) *Structures Kit:* ☐ Single tube model culvert ☐ Double tube model culvert ☐ 1” model box culvert ☐ ½” model box culvert	*Scientific/Academic Kit:* ☐ Emriver level rod and holder ☐ Graduated cylinder (250 ml) ☐ Graduated cylinder (1000 ml) ☐ Graduated beaker (2000 ml) ☐ Stopwatch ☐ Coarse mesh hand sieve ☐ Perforated scooper ☐ Hand size scooper (not perforated) ☐ Concentrated dye (blue) ☐ Concentrated dye (green)

Assembly and Operation

WARNING
When fully charged with water, the model can weigh in excess of 1,200 lb (544 kg). Dynamic loading during use, caused by someone leaning on the model, for example, can greatly increase this load. A collapse of the model's supports could be dangerous and seriously damage the model. You must be certain the model is adequately supported and that you have read and understand all warnings.

STEP 1 – Set up the supports

Begin by setting up the aluminum supports. The shorter support will hold the downstream end of the box, so keep in mind how you would like the model oriented when placing the supports.

If the supports are not properly aligned, the box will twist when fully loaded, which may damage the box. To check alignment, look across the support points as shown in Figure 1. The supports must be both level and parallel.

Figure 1. Incorrect (left) and correct (right) support alignment. Crossbars must be both level and parallel when viewed as shown.

The supports should be set up so that the crossbars are 58 in. (1.5 m) apart and aligned as shown in Figure 1 to prevent damage to the box.

On uneven ground, use shims made from ¾ -inch plywood or 2-by-4 scraps under the support feet as necessary.

Be sure all four feet of each support are stable. One support is modified to provide clearance for the downstream reservoir (see Figure 3). Place the supports so this opening lies at the downstream end.
The supports provided have a difference in height of about 3 in, yielding a box slope of 5%.

The slope of channels in the box will be determined by the position of the standpipe, so the exact box slope is not necessarily important.

Note: Labels on the supports display arrows that indicate proper placement and orientation of supports, with the shorter support at the geomodel's downstream end.

STEP 2 – Install the box

The box must be supported at the two reinforced ribs, and nowhere else. See Figure 2.

Figure 2. The support ribs are indicated with arrows. The box must only rest on the supports at the reinforced ribs shown.

CAUTION
The supports must be properly aligned with the support ribs on the box before any weight is added to the box.

When the supports are level and aligned, lift the box onto the supports. This task requires at least two people, because the box weighs 95 lbs (43 kg). Check to ensure that the box rests directly on top of the supports at the reinforced ribs shown in Figure 2.

Note: Gaps of more than 0.25 in (6 mm) between the box's reinforced support ribs and the support crossbars indicate that the supports are NOT properly aligned.

STEP 3 – Install the standpipe in the drain assembly

Install the standpipe by sliding it into the drain assembly from the **bottom of the box**. Insert the aluminum handle first. The seal may be damaged if you insert the standpipe from above. For initial setup, the standpipe should extend into the box approximately 2 in (50 mm).

The standpipe will move much more freely in the drain assembly seal when wet — you may want to moisten the standpipe before inserting it.

The standpipe has been lubricated with a silicone grease to allow smooth action against the rubber seal. This lubricant is waterproof, nontoxic, and should last for many uses. As needed, apply a small amount to restore smooth movement. This silicone grease may be found at most hardware stores and is typically used for waterproofing electronics and o-rings. An extra tube of silicone grease has been provided with your model. **Keep the standpipe coated with a thin film of silicone grease** to ensure years of trouble-free operation.

STEP 4 – Position the reservoirs

The Em3 uses two reservoirs: an upstream reservoir and a downstream reservoir.

Figure 3. This is how the model should look after completing steps four and five. Note the orientation of the two reservoirs with respect to the upstream and downstream ends of the box.

The downstream reservoir features aluminum struts to support the sediment trap. See Figure 4.

Figure 4. The downstream reservoir has aluminum struts.

Place the upstream reservoir (this one **does not** have aluminum struts) beneath the upstream end of the box so that the valve faces toward the downstream end of the box.

Figure 5. Place the reservoir beneath the upstream end of the box.

Place the downstream reservoir beneath the downstream end of the box, directly below the standpipe, so that the valve faces toward the upstream end of the box. Note that the support horse at the downstream end of the box has an opening for the reservoir. See Figure 6.

Figure 6. Place the downstream reservoir beneath the downstream end of the box.

STEP 5 – Attach reservoirs

When fully assembled, the tubing will run between the two reservoirs. See Figure 3.

Place the one-inch diameter tubing under the box. Feed the tubing underneath the supports.

Figure 7. The one-inch tubing connects the two reservoirs.

Attach the fitting on the tubing to the valve on the upstream reservoir. The reservoir valve plugs into the fitting on the tubing.

Figure 8. Attach the tubing fitting to the valve on the upstream reservoir.

Snap down the metal clips toward the tubing to secure the fitting to the valve.

Figure 9. Bend the metal clips down toward the tubing.

Figure 10. How the tubing fitting and reservoir valve look when properly connected. Note that the metal clips must be snapped down toward the tubing.

Repeat **Step 5** at the opposite end to attach the tubing to the downstream reservoir.

STEP 6 – Position the pump and connect tubing to outlet

Place the pump inside the upstream reservoir, lying on its side.

Figure 11. Place the pump inside the upstream reservoir.

Attach the pump tubing to the outlet fitting on the underside of the upstream end of the box. Slide the tubing over the fitting until the tubing meets the vertical part of the fitting.

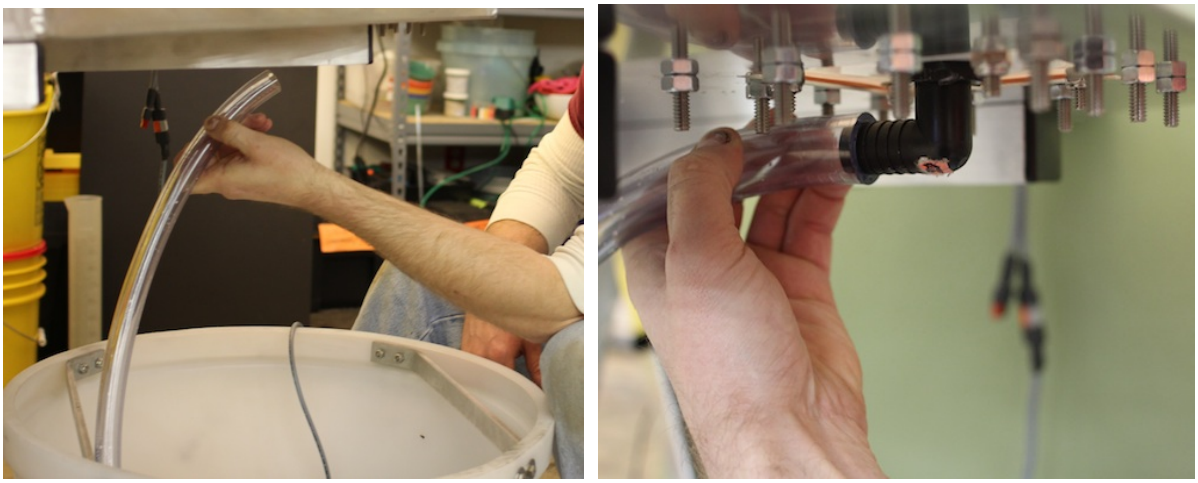

Figure 12. Slide the pump tubing over the outlet fitting

Attach the clamp to the outside of the tubing where it covers the outlet fitting.

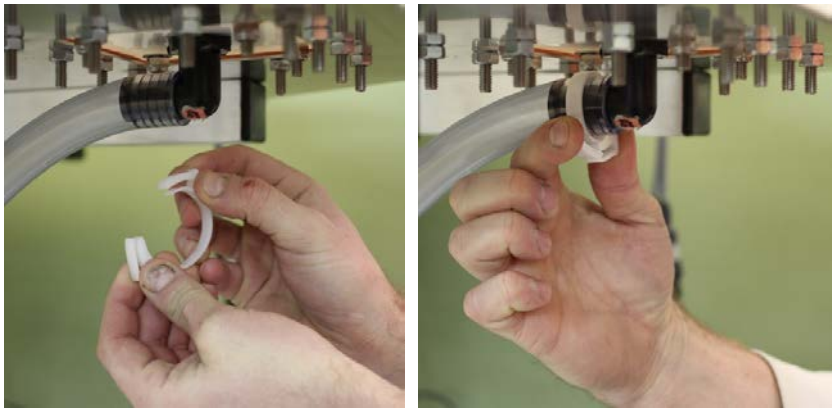

Figure 13. Place the clamp around the pump tubing and outlet fitting.

STEP 7 – Position the sediment trap

Place the sediment trap on the aluminum struts in the downstream reservoir. Be sure the sediment trap sits directly below the standpipe.

Figure 14. Place the sediment trap on the aluminum struts in the downstream reservoir.

STEP 8 – Fill the box with modeling media (sediment)

Pour the media into the box one bucket at a time. Spread the media using the scraper included with your geomodel to distribute it evenly throughout the box.

> **Handling the media:** During experiments and demonstrations, sediment leaving the box will accumulate in the sediment trap. The rate at which the sediment trap fills is highly variable, depending on activity in the box.
> When the sediment trap becomes full, use the perforated scoop included with the Emriver model to return sediment to the box.

Allowing sediment to accumulate in the reservoirs will **NOT** harm the system. The filters are sized to allow the system to function normally even when completely buried in sediment. However, fine debris such as dirt, lint and pollen can accumulate in the media over time and clog the filters. Just give them a rinse now and then.

STEP 9 – Fill the reservoirs

Both reservoirs are graduated in US gallons. Each reservoir has a 27-gallon capacity. **Before filling the reservoirs, be sure the valves are open to allow water to flow between the two reservoirs.**
Using the graduations on the reservoirs, fill one reservoir with 20 gallons of water. Wait for the water to equalize between the two reservoirs. This may take a few minutes. Continue to fill the reservoirs until each reservoir contains 20 gallons for a total of 40 gallons in the system.

Position the reservoirs before filling them with water. **Do not move the reservoirs after they have been filled, as this will cause damage to the reservoirs. Do not fill the system with more than 40 gal of water.**

WARNING
Using more than 40 gal (151 L) of water could damage the box or cause it to collapse. Do not exceed this volume and **do not start the pump** until you have filled the reservoirs and carefully measured the total volume of water in the system.

WARNING
When full of water, each reservoir weighs over 175 lb (79 kg). They will be damaged or destroyed if moved when full.

STEP 10 – Power the pump

Attach the brick power supply to the leg of the taller support horse at the upstream end using the mushroom fasteners on the support horse and the brick power supply. Wrap the Velcro® strap around the support leg and the brick power supply to fasten securely.
See Figure 15.

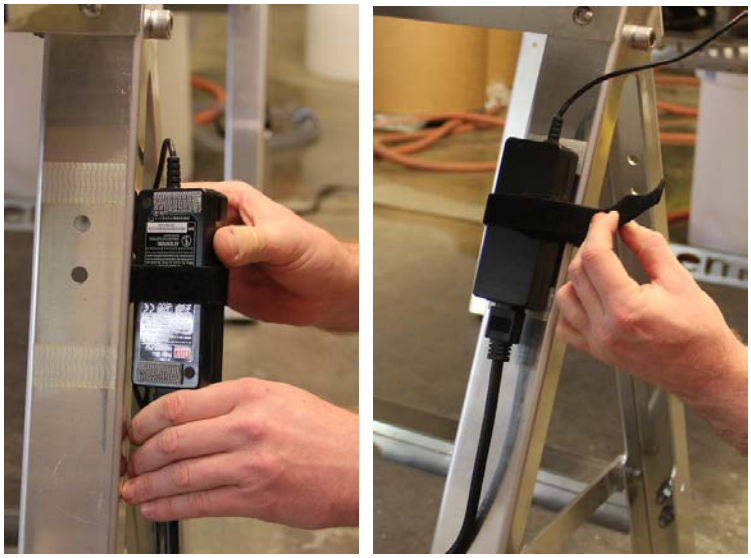

Figure 15. Attach the brick power supply to the upstream support horse using the mushroom fasteners. Wrap the Velcro® strap around the support leg.

Connect the power cord to the Ground Fault Circuit Interrupter (GFCI). If you are using an extension cord, connect the extension cord to the GFCI. Do not plug the model's power cord directly into an outlet. **Always use the GFCI.**

This applies only to Emriver users in the USA. Export models are shipped with appropriate CE-approved power supplies and connectors.

Figure 16. Always use the Ground Fault Circuit Interrupter (GFCI).

STEP 11 – Attach the Crayfish Electronic Flow Controller

Attach the flow controller to the upstream end of the box using the mushroom fasteners on the box and the back of the controller. See Figure 17.

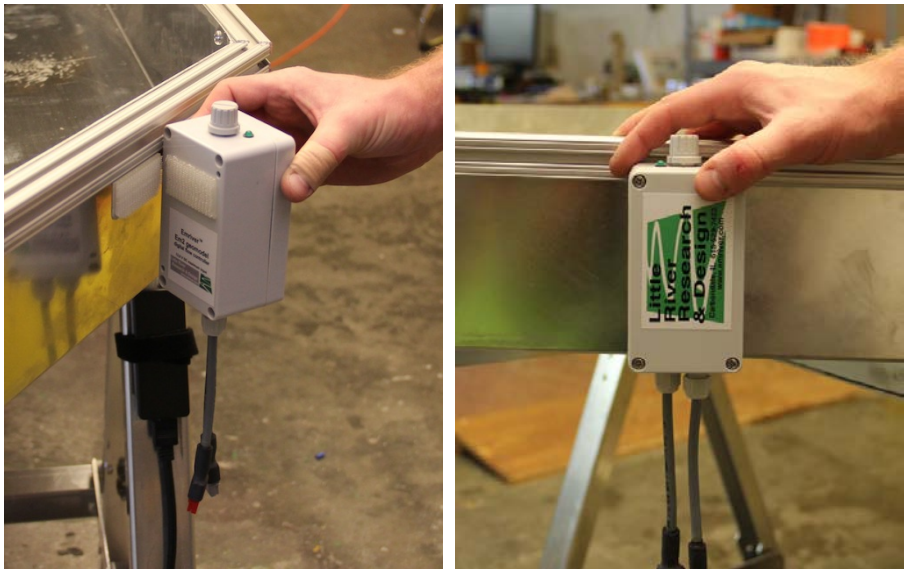

Figure 17. Attach the controller to the upstream end of the box using the mushroom fasteners.

**If you purchased the Alix Digital Flow Controller, see the Alix Controller Instructions for Use, located in the front flap of this manual.

STEP 12 – Connect power

Emriver system power connectors are color-coded. The pump connects to the flow controller via orange and grey connectors, and the power supply connects to the controller via red and black connectors.

Connect the pump to the flow controller by connecting the gray and orange connectors. Then, connect the flow controller to the power supply by connecting the black and red connectors. See Figure 18.

Figure 18. Connect the pump to the controller with the orange and grey connectors.
Connect the power supply to the controller with the red and black connectors.

Change flow rate using the knob on the controller. An indicator light displays when the power is on.

***Note*:** The knob does not turn the pump off completely. The pump is on as long as the power is connected. To completely turn off the pump, the power must be disconnected.

Setup Checklist

1. Read and understand all warnings in this manual.
2. Find a hotel lobby, gravel bar, laboratory or other surface with a slope of less than 8%
3. Set up the supports so the crossbars are 58 in. (1.5 m) apart, with a height difference of 3 in (76 mm). Check that the supports are aligned properly to avoid twisting of the box. **Check the supports for damage and loose connectors before setting up the model.**
4. One of the supports has an opening for the downstream reservoir – be sure to place this support at the downstream end with the opening for the reservoir facing out. Labels on the supports display arrows that indicate correct placement and orientation. Use these arrows as a guide for proper support setup and reservoir placement.
5. Place the box on the supports. Before adding any weight to the box, be sure that the support ribs on the box bottom rest directly on the supports, and that there are no gaps greater than 0.25 in (6 mm) between the supports and the box support ribs.
6. Insert the standpipe into the drain assembly from the bottom of the box so that the standpipe extends at least 2 in (50 mm) inside the box.
7. Place the upstream reservoir beneath the upstream end of the box with the valve facing downstream. Place the downstream reservoir beneath the downstream end of the box with the valve facing upstream.
8. Place the one-inch diameter tubing beneath the box so that it runs parallel to the length of the box. Attach the tubing's valve fitting to the valve on the upstream reservoir and the opposite valve fitting to the valve on the downstream reservoir. Snap the metal clamps down toward the tubing.
9. Place the pump inside the upstream reservoir. Attach the pump tubing to the outlet fitting beneath the upstream end of the box. Fasten the tubing clamp around the pump tubing where it covers the outlet fitting.
10. Place the sediment trap on the aluminum struts in the downstream reservoir. Be sure the sediment trap sits directly below the standpipe.
11. Fill the box with modeling media.
12. Fill the system with 40 gal (151 L) of water using the graduations on the sides of the reservoirs. Be sure the valves on the reservoirs are open while adding water. Add 20 gallons first and allow the water level to equalize between the two reservoirs before adding more water. **Do not fill the system with more than 40 gal (151 L) of water.**
13. Fasten the brick power supply to the leg of the upstream support. Plug the model's power cord into the GFCI provided with the model and plug the GFCI into a wall outlet. **Never plug the model's power cord directly into a wall outlet.**
14. Fasten the Crayfish Electronic Flow Controller to the side of the box at the upstream end.
15. Connect the flow controller to the pump via the orange and gray connectors. Connect the power supply to the flow controller via the black and red connectors. Adjust the knob on the controller to desired flow rate.
16. Begin demonstrations and experiments.

Disassembly, Transport and Storage

When breaking down the model, remember that **the reservoirs cannot be moved while full of water.**

- It is easiest to use the pump and tubing to drain the reservoirs.
- Remove the pump tubing from the outlet fitting at the upstream end of the box. Place the tubing into a media bucket (or any container that can be carried while full of water) or directly into a proper drainage area.
- Turn on the pump to move water from the reservoir to a smaller container or to a drain. Repeat until all of the water is removed from the reservoir.

As much as 20 gal (76 L) of "groundwater" will remain in the media and box after the pump has been turned off and flow from the standpipe has slowed to a deceptive trickle. Before storage of the model, most of this remaining water must be drained from the sediment. This water can take several hours to drain.

Pile the media at the upstream end of the box to aid drainage. You can also remove the standpipe to speed along the process. You may also elevate the upper end of the model with a 2-inch shim between the box's support rib and the support horse.

Note: To prevent growth of mold and bacteria, add about 10 ml of household bleach to the buckets if you plan to store them wet.

Maintenance and Care

Clean plastic parts with mild detergents. Do not use solvents, which may dissolve or weaken the plastic. If the tubing is left in the sun while wet, it may support algae growth and become cloudy. Routing a mild bleach solution through the tubing after use will minimize this problem. Removing all standing water in the lines will help as well.
If tubing becomes cloudy or damaged, contact us for replacement. Tubing from your local hardware store will work, but the tubing that is supplied with your model is a high quality type and is longer lasting and more flexible.

All bolts on the supports should be periodically checked for tightness. Loose or missing bolts will affect the strength of the supports. The bolts should be as tight as possible while still allowing the supports to fold.

Clean the filter on the pump and the filter inside the downstream reservoir periodically.

- To clean the pump filter, unscrew it from the pump and thoroughly rinse it inside and out.
- To clean the reservoir filter, unscrew it from the inside of the reservoir and rinse it inside and out.
- You may also set the filters in a diluted bleach solution (2-3% bleach) for approximately 1-2 hours.

The water in the system should be changed between each use. Never leave the system sitting unused and filled with water for more than a few days. If you need to conserve water, **add about 12 mlof household bleach to the reservoir every two days or so, and run the pump to distribute it through the system**. This will prevent algae and bacteria from colonizing the model.

Use care, adding too much bleach or chlorine can damage the aluminum parts.

Demonstrations and Experiments

The primary independent variables imposed on your experimental channels are channel slope and discharge. To gain familiarity with the capabilities of the model, it is best to begin by exploring both of these variables at relatively low values.

Slope is controlled by the slope of the box (which is 5% when you set up the model on a level surface) and by the elevation of the standpipe. Slope of your channels is also dependent, of course, on their sinuosity. It is best to begin with lower slopes. A small laser level can be used to explore the relative elevations of the upper end of the channel and the standpipe. The modeling media is manufactured within a range of specifications and its specific gravity can vary from batch to batch. This may cause slightly different sediment behavior in different models.

As you are learning to use the model, begin with low flows (about 25 ml/s). These flows may seem too low at first glance, but low flows often give the most interesting results. Higher flows will mobilize all sediment in the channel, which, in many demonstrations and experiments, will make it difficult to see specific processes. Try forming a channel with moderate flows (less than 75 ml/s), and then lowering the discharge to find the point at which sediment transport in the channel ceases. Work up from this point.

When forming experimental channels, mimic what you see in the field. For example, meandering gravel-bed rivers will have low point bars that slope gradually up to a floodplain, and relatively steep banks on the outsides of bends. Routing brief flood pulses (high flows of about 190 ml/sec) through your channels will give them more realistic characteristics. Remember that your modeled channels should be in a near-equilibrium condition in order to show the effects of disturbances. The guidelines and videos at the following places will help you begin.

- www.emriver.com
- http://serc.carleton.edu/NAGTWorkshops/geomoph/emriver/index.html
- Emriver DVD (located in front flap of this manual)

You may want to add sediment to the small pool that usually forms just downstream of the energy dissipater. This prevents the upper ends of your channels from being sediment-starved.

Specifications

Emriver Component		Specifications
Modeling Media	Modeling media material	Particulate thermoset plastic
	Modeling media (sediment) dry wt	240 lbs (109 kg)
	Sediment specific gravity	1.55
	Sediment particle size	0.02-0.09 in. (0.5-2.1 mm)
Box	Box weight	95 lbs (43 kg)
	Box dimensions	39 x 120 x 5.5 inches (1 x 3.05 x 0.14 m)
Reservoirs	Water capacity of each reservoir	27 gal (102 L)
	Total system water capacity	40 gal (151 L)
Pump	Pump capacity	12V DC marine pump, rated 800 gph at 3.8 amps
Entire system	Wt. of entire system (dry)	Approx. 400 lbs (181 kg)
	Wt of entire system (wet, @ 40 gal)	Approx 720 lbs (327 kg)
	Minimum floor space required for demonstration	9 ft x 16 ft (3 m x 5 m)