Emriver Em2 Geomodel
Use and Care Manual

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

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

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

Check all fittings on the aluminum 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 collapse when loaded. Make sure spreader bars are fully engaged.

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

Never use more than 27 gal (102 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 150 lb (68 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 Emriver Em2. Be certain to connect the power supply to a properly grounded outlet. Always use the Ground Fault Circuit Interrupter (GFCI) provided with the Emriver model (see Figure 18), and be sure to read the manual that accompanies the GFCI.

When using a 12-volt battery to power the model, always use the Emriver Battery Adapter from 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.

Introduction

Introduction

This manual describes the safe use and maintenance of your Emriver Em2 river process simulator. It is very heavy when filled with modeling media and water, and could be dangerous if not properly supported, assembled, and operated.

Therefore, it is important that you 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 model may be found at www.emriver.com.

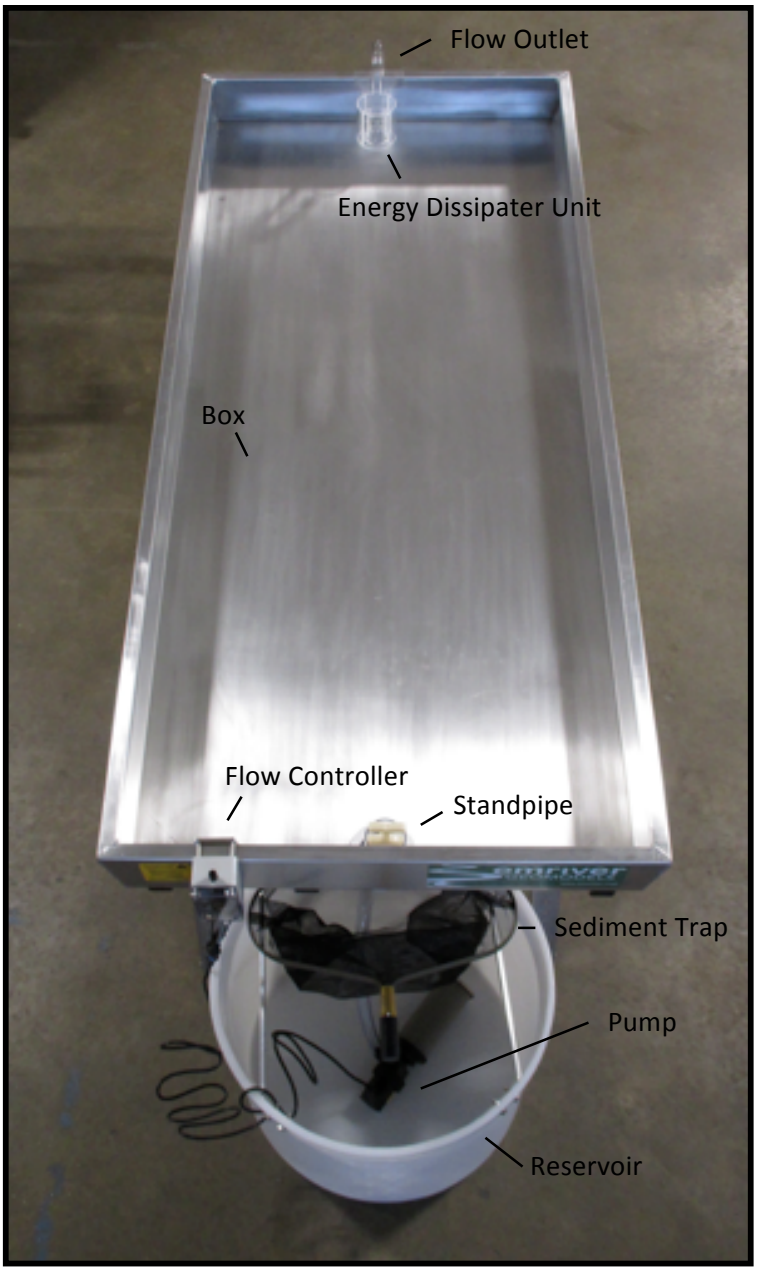

Figure 1. Parts of the Emriver Em2 river process simulator. Power supply is shown in Figure 2.

Figure 2. Power supply included with the Emriver Em2 model, shown attached to the downstream support.

Parts and Accessories Checklist

Emriver parts and accessories checklist:	Other parts and supplies you may want to have on hand:
☐ Emriver Em2 Box ☐ Modeling media in 5 buckets ☐ Emriver Use and Care Manual ☐ Emriver Lab Materials ☐ Standpipe ☐ Emriver supports ☐ Reservoir ☐ Sediment trap ☐ Pump and filter ☐ ¾-inch-diameter tubing ☐ Electronic Flow Controller ☐ Energy Dissipater Unit (EDU) ☐ Flow outlet ☐ Power supply ☐ GFCI-equipped outlet ☐ Hydraulic shapes ☐ Measuring tape ☐ Solid scoop ☐ Perforated Scoop ☐ Riprap stones ☐ Simulated riparian vegetation ☐ Scrapers for moving media ☐ Blue and green dye	☐ Paper towels and mop ☐ Shim materials ☐ Hand level ☐ Plastic buckets for sediment and water ☐ Garden hose ☐ Scraper/trowel ☐ Squeegee ☐ 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:	
☐ Digital Flow Controller ☐ Emriver Battery Adapter *Structures Kit:* ☐ Box culverts ☐ Walled culvert ☐ Double walled culvert ☐ Model houses	*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)

WARNING
When fully charged with water, the model can weigh in excess of 500 lb (227 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

To assemble the model, 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 crossbars as shown in Figure 3. The supports must be both level and parallel.

The supports should be set up so that the crossbars are 49 in (1.25 m) apart and aligned as shown in Figure 3 to prevent damage to the box.

Figure 3. Incorrect (left) and correct (right) support alignment. Crossbars must be both level and parallel when viewed as shown.

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 properly supported. One horse is modified to provide clearance for the reservoir (see Figure 9). Place the supports so this opening lies at the downstream end.

The Emriver supports have a difference in height of about 3 in (76 mm), yielding a box slope of 6%.

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, with the shorter support at the geomodel's downstream end. See Figure 4**.**

Figure 4. Labels on the supports indicate proper orientation, with the shorter support at the downstream end.

STEP 2 - Install the standpipe in the drain assembly

Install the standpipe by sliding it into the drain assembly from the **underside of the box**. Insert the 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 and can be found inside the red carrying case. **Keep the standpipe coated with a thin film of silicone grease** to ensure years of trouble-free operation.

The drain assembly nut should not be over tightened. Some water should leak from around the drain assembly, down the outside of the standpipe, and into the reservoir. This flow allows "groundwater" to exit the media and improves river modeling performance.

Figure 5. Insert the standpipe from the underside of the box to avoid damage to the seal. The standpipe will move much easier when the seal is wet. Never attempt to install the standpipe from the top of the box.

STEP 3 - Install the box

The box MUST be supported at the two reinforced ribs, and nowhere else. See Figure 6.

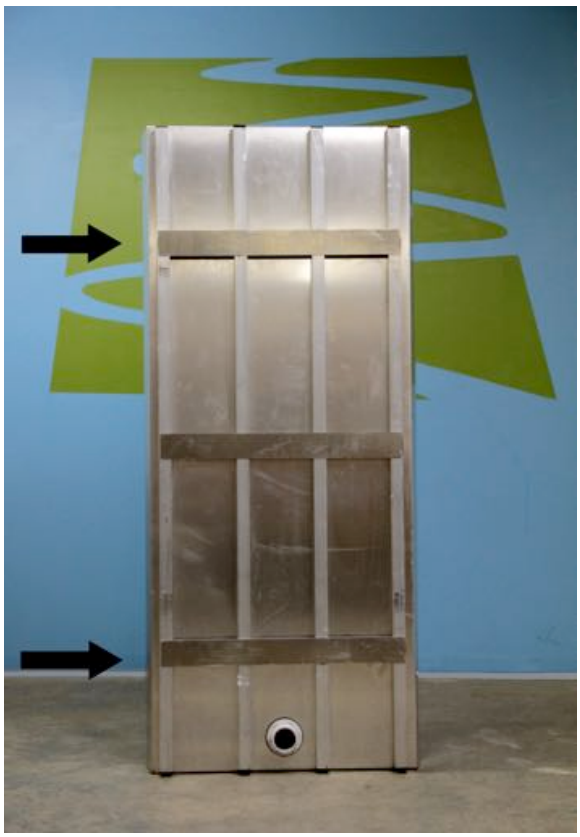

Figure 6. Support ribs on the underside of the box (indicated with arrows) are areas where the box must be supported.

CAUTION
The supports must be properly aligned with the support ribs on the box before any weight is added to the box. See Figure 8.

When the supports are level and aligned, place the box on them.

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

Figure 7. Lift the box onto the supports. It is best to complete this task with two people.

Figure 8. Check to ensure that the support ribs on the box rest on the supports properly.

STEP 4 - Position the reservoir

Place the reservoir beneath the box at the downstream end. The reservoir should be located as shown in Figure 9 so that the standpipe will drain into the reservoir. Note that the support at the downstream end of the box has an opening for the reservoir.

Figure 9. Place the reservoir beneath the support at the downstream end.

STEP 5 - Position the pump

Attach one end of the tubing onto the arm of the pump. Place the pump, lying on its side, in the bottom of the reservoir, keeping the wire connectors outside of the reservoir. Check that the filter is securely attached to the pump. *Note that you may have a pump and filter that look different than those in the photo, but the setup is the same for each.*

Figure 10. Place the pump with filter in the bottom of the reservoir, lying on its side. The filter easily screws onto the pump. The tubing is attached to the arm on the pump.

STEP 6 - Fill the reservoir

Using the graduations on the reservoir, fill it with 27 gal (102 L) of water. The reservoir is graduated in U.S. gal. Position the reservoir before filling it with water. **Do not move the reservoir after it has been filled as this will cause damage to the reservoir. Do not fill the reservoir with more than 27 gal (102 L) of water.**

WARNING
Using more than 27 gal (102 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 reservoir and carefully measured the total volume of water in the system.

WARNING
When full of water, the reservoir weighs over 200 lb (91 kg). It will be damaged or destroyed if moved when full.

STEP 7 - Position the sediment trap

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

Figure 11. Place the sediment trap on the aluminum struts in the reservoir.

STEP 8 - Attach and position the tubing and flow outlet

Attach bracket to the U-Tube flow outlet by compressing the bracket and sliding it onto the tube. Then fit the flexible tubing from the pump onto the outlet and secure with the plastic hose clamp as shown in Figure 12.

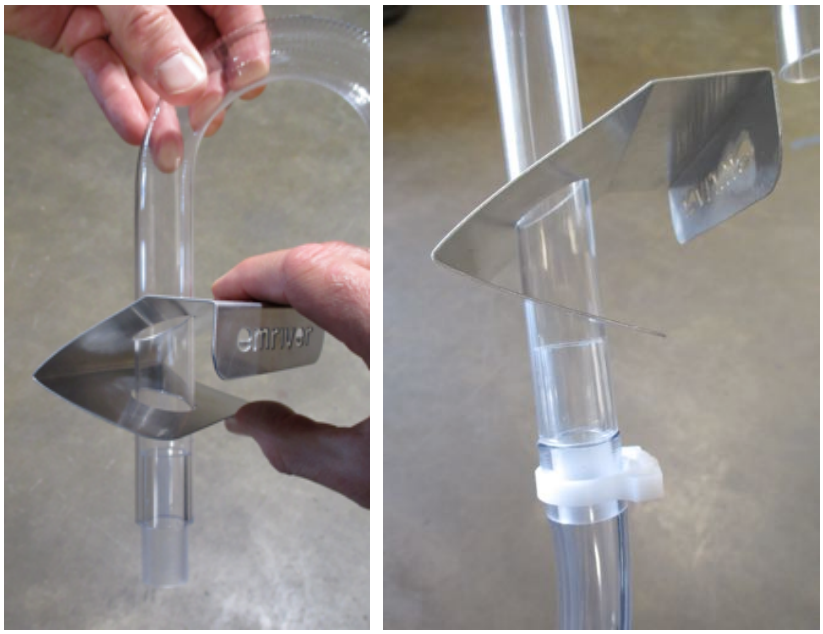

Figure 12. Attach the bracket to the U-Tube flow outlet and attach the flexible tubing.

Place the bracket and outlet at the center of the upstream end of the box. If the flexible tubing is turning the outlet, loosen the plastic tubing clamp and twist it so the tubing can be easily positioned through the supports and the outlet is perpendicular to the upstream end of the box.

Figure 13. Hang the flow outlet bracket in the center of the upstream end of the box.

STEP 9 - Position the Energy Dissipater Unit

Place the Energy Dissipater Unit (EDU) beneath the flow outlet. The flow outlet opening should line up with the innermost cylinder of the EDU. The EDU's Y-shaped opening should face downstream. See Figure 23 for a photo of the EDU while in use.

Figure 14. Place the EDU beneath the flow outlet.

STEP 10 - 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. See Figure 16.

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 reservoir will **NOT** harm the pump. The filter is sized to allow the pump 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 this filter. Just give it a rinse now and then.

Figure 15. Pour the media into the box

STEP 11 - Power the pump

Attach the brick power supply to the leg of the shorter support using the mushroom fasteners on the support and the brick power supply. Wrap the Velcro® strap around the support leg and the brick power supply to fasten securely. See Figure 16.

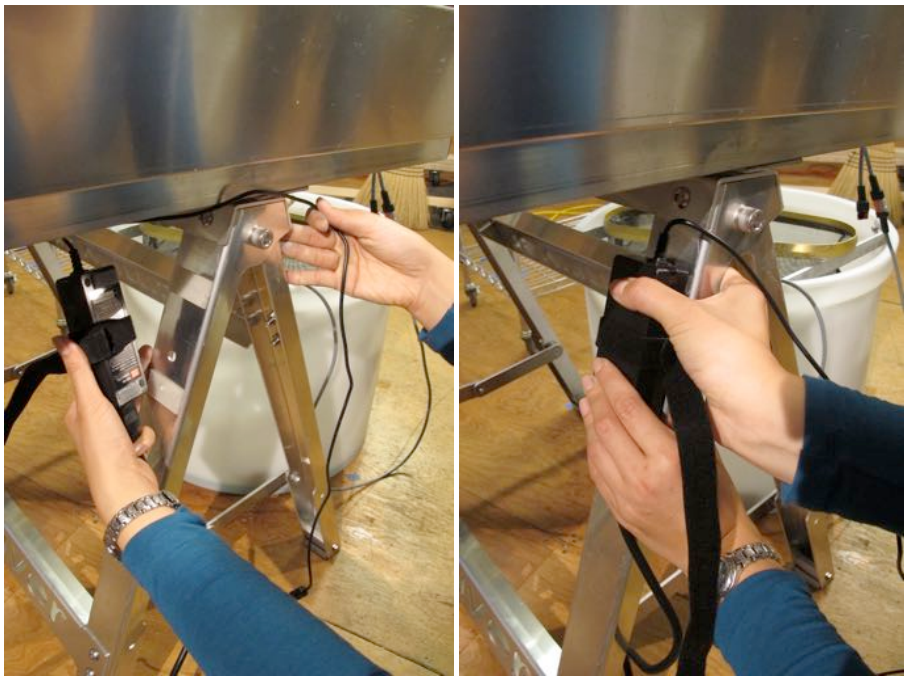

Figure 16. Attach the brick power supply to the leg of the downstream support.

Connect the power cord to the Ground Fault Circuit Interrupter (GFCI) (US users only). If you are using an extension cord, connect the extension cord to the GFCI. Do not plug the model's power cord directly into a wall outlet. **Always use the GFCI.**
If the red indicator light on the GFCI is on, it is ready for use and the model should be powered. If the red indicator light is off, press the red "Reset" button.

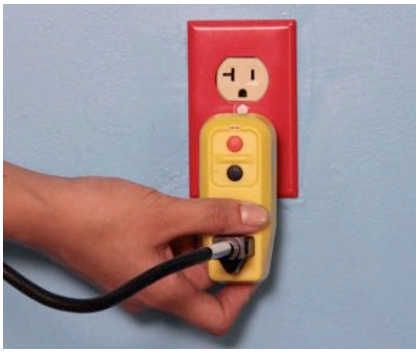

Figure 17. Always connect the power cord to the GFCI. Never plug the model's power supply directly into a wall outlet.

STEP 12 - Attach the Electronic Flow Controller (Model K28, or older *Crayfish*)

If you purchased the Digital Flow Controller (Model K500, or older *Alix*), see the separate instruction sheet. Attach the flow controller to the downstream end of the box using the hook *(note that some older controllers have a Velcro connection)*. See Figure 18**.**

Figure 18. Attach the controller to the downstream end of the box.

Connect the pump to the controller using the gray, blue, and orange connectors (note there is one red tab that is not a connector). Then, connect the controller to the power supply using the black and red connectors. See Figure 19. *Note that older models of the pump and controller have different connectors. The older models will not work with the new models as shown here. Simply match up the colors on the connectors.*

Figure 19. The pump, at left, connects to the flow controller, middle. The flow controller, right, connects to the power supply. The color-coded connectors on each component will match up.

A square, red indicator light in the circuit board displays when the power is on. Change flow rate using the knob on the controller. Pressing the knob resets the flow to zero. See Figure 20**.**

Troubleshooting: If the controller does not produce flow, and there are no lights on the circuit board, check the power supply to ensure that the cord is fully connected and that there is a light on the power brick.

If the power light is on, but there is no flow, check to see that the flow indicator LED is lit on the circuit board (round green light). If it is lit, check the connection between the controller and the pump. Also check for any obstructions or clogged filters. Expel all air from pump and hose. If the flow indicator LED is not lit, adjust the knob clockwise until the LED is lit and there is flow.

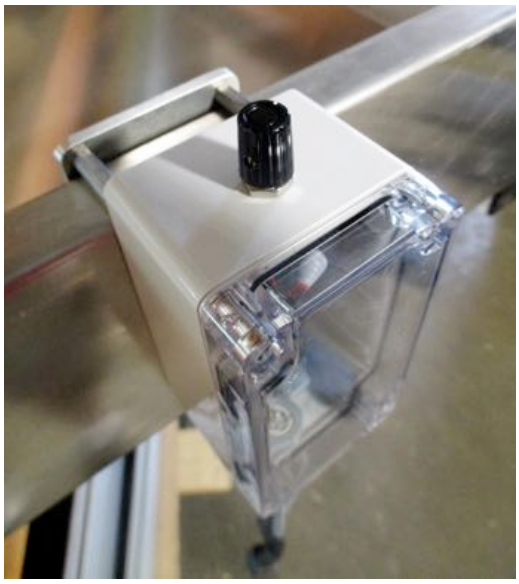

Figure 20. Turn on the pump and control flow with the knob.

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

Note**:** If the pump is reluctant to prime when started, reorient or shake it a bit (while underwater) to remove air trapped in its intake. If necessary, clean any debris from the filter by unscrewing it from the pump and flushing it with water.

Flow Pathways

After the Emriver Em2 model has been assembled according to the instructions in this manual, it is ready for use. Figure 21 is a conceptual chart that shows flow pathways of water and electricity through a properly assembled Emriver Em2 model during use.

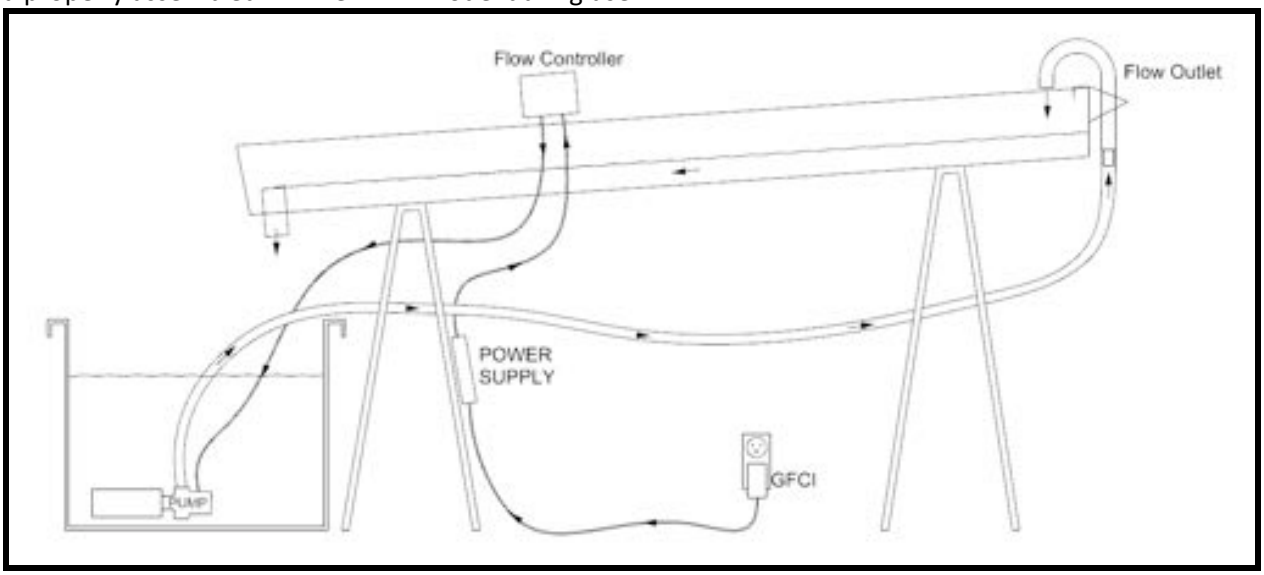

Figure 21. Flow pathways for water and electricity.

Setup Checklist

1. Read and understand all warnings in this manual.

2. Find a surface with a slope of less than 8%.

3. Set up supports so the crossbars are 49 in (1.25 m) apart. Check that the supports are aligned properly to prevent 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 reservoir – be sure to place this support at the box's downstream end with the opening for the reservoir facing downstream. 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. Insert the standpipe in the drain assembly from the underside of the box so that the standpipe extends at least 2 in (50 mm) inside the box.

6. Place the box on the supports. Before adding any weight to the box, be sure that the support ribs on the box's underside rest directly on the supports, and that there are no gaps greater than 0.25 in (6 mm) between the support crossbars and the box support ribs.

7. Place the reservoir under the standpipe and place the pump in the reservoir, lying on its side. Check the pump filter for fine debris.

8. Fill the reservoir with 27 gal (102 L) of water using the graduations on the inside of the reservoir. **Do not exceed 27 gal (102 L).**

9. Place the sediment trap on the aluminum struts in the reservoir. Be sure the sediment trap sits directly beneath the standpipe.

10. Connect the tubing and flow outlet. Attach the flow outlet to the box. Place the Energy Dissipater Unit under the outlet. The innermost cylinder of the EDU must align with the mouth of the flow outlet and the EDU's Y-shaped opening should face downstream.

11. Fill the box with modeling media.

12. Fasten the brick power supply to the leg of the downstream 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.**

13. Attach the Electronic Flow Controller to the box.

14. Connect the power supply to the flow controller. Connect the controller to the pump. Match the color-coded connectors. Adjust the knob on the controller to desired flow rate.

15. Begin experiments and demonstrations.

Disassembly, Transport, and Storage

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

- It is easiest to use the pump and tubing to drain the reservoir.
- Remove the flow outlet from the tubing and place the tubing so that water drains into a container that can be carried when full of water (media buckets work well for this purpose) or directly into a proper drainage area. See Figure 23.
- Turn on the pump to move water out of the reservoir.

As much as 10 gal (38 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.

The sediment is biologically inert and can be removed from the model and stored damp, though it is best to provide a means for drainage. A 40- or 50-gal container with a few holes in the bottom works well. A scrap of plastic filter cloth over the holes will keep sediment from being lost. Remember that the sediment may weigh well over 200 lb (91 kg) when wet.

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.

Figure 22. Place the tubing so that it drains into a smaller, separate container if there is no drainage area nearby. Turn on the pump to move water out of the reservoir.

- Drain the model and reservoirs after each use; do NOT leave water in the Emriver models.

- To keep your model sanitary, change out the water every day and drain the table by lowering the standpipe all the way.

- If you cannot change the water every day, add about 6 ml of household bleach to the reservoir every day, and run the pump to distribute it through the system. This will prevent algae and bacteria from colonizing the model. You may also use widely available home water filters to remove contaminants. **Adding too much bleach or chlorine can damage the aluminum parts.**

- Never use lithic materials (i.e., sand) in the Emriver tables.

- Do not use metallic objects in the model.

- Power down the pump and controller after each use by disconnecting the pump from the controller, and disconnecting the controller from the power supply.

- Do not use solvents, which may dissolve or weaken the plastic tubing. 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 you may purchase a replacement from us, or buy from your local hardware store, but that which 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 periodically by unscrewing the filter from the pump and thoroughly rinsing it inside and out.

Quick Start Guide for the Emriver Em2

Some basic guidelines for using the Emriver are included here. Further instructions and exercises can be found in the **Emriver Lab Manual**. In addition, 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); all videos are also available as a Playlist on our YouTube channel. The link is available from our website.

General Tips

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 6% when you use the support horses on a level surface) and by the elevation of the standpipe. A 6% slope makes for a fast-moving stream when the standpipe is lowered. Raising the standpipe to 2 inches will reduce the effective slope to 3%, and raising it fully will reduce the slope to nearly zero. This is the easiest way to control the slope of your model.

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, as seen in Figure 23, left side). These flows may seem too low at first glance, but low flows often give the most interesting results. Higher flows (about 125 ml/sec, shown in Figure 24, right side) 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 flow to find the point at which sediment transport in the channel ceases. Work up from this point.

Figure 23. Low flow (left) and high flow (right) as it appears when looking at the EDU.

When you notice media being scoured from in front of the EDU, you may replenish it by pushing the banks closer together adjacent to the scour or by sprinkling media directly into the stream. If you pile the media excavated from your initial channel near the EDU, you will have a ready supply. Placing 8-10 pieces of limestone riprap directly under the outlet of the EDU will further calm the stream and reduce scouring.

A straight channel from the EDU to the standpipe in your river model will eventually form meanders, point bars, cutbanks, and other river features just as in nature, but it may take a couple of hours for these features to fully develop. Below are a couple of initial conditions that can produce features more quickly for teaching and demonstrating.

Meandering Channels

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, see Figure 24, right side) 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.

Delta Building

To explore delta building and alluvial fans, move most of the media to the upstream 2/3 of the box and distribute it evenly. The downstream third of the box can have the aluminum 'bedrock' exposed, or may have a thin layer of media in it. You may wish to remove one 5-gallon bucket of media from the model.

Cut a straight or meandering incision in the media from the EDU to the beach and sculpt a gentle slope in the media away from your initial channel with the plastic scraper or the corner of a scoop. You may have media above the edge of the box at the upstream end of your model.

Raise the standpipe to 7cm (2.75”) and start the pump, adjusting the flow to about 100 ml/s. The EDU will be about half-filled with water. Sediment will immediately begin moving downstream, and will be deposited in the forming lake at the downstream end of the model. As the lake fills, you will begin to see all the classic delta formation phenomena in the model. Periodically raising and lowering the standpipe will mimic rising and falling tides or sea level change and introduce layers of complexity to the delta. Raising and lowering the flow rate of the pump will further add to the dynamic qualities of the model.

Stratigraphy

If you have color-coded media in your model, examining the stratigraphy can give fascinating insight into the depositional history of your experiments. As in nature, the most complex stratigraphy is often the result of long-term deposition under dynamic conditions. Flood sequences, meandering channels, delta building, and other fluvial processes all leave different marks on the stratigraphic record.

The best way to examine the stratigraphy in your model is to drain it overnight so the media can pack down. (Saturated media has lower cohesion than damp media.) Use the corner of a large scoop to cut V-shaped incisions laterally across the media bed. Cutting into the media this way magnifies the thickness of the layers and keeps the cut wall from collapsing.

Cleanup

When you are ready to put your Em2 away, dry the media as much as possible by fully draining the model and piling the media in the middle of the box for a day or so if possible. Scoop as much media as you can back into the buckets. If the reservoir is still full of water, remove the standpipe, pull the inlet tube from the end of the hose, and use the pump to wash all remaining media out of the box and into the sediment trap. A small squeegee is ideal for coaxing the last bits of media to the hole.

Specifications

Emriver item		Specifications
Modeling media	modeling media material	particulate thermoset plastic
	modeling media (sediment) dry wt.	150 lb (68.2 kg)
	sediment specific gravity	1.55
	sediment particle size	0.02 - 0.09 in. (0.5 - 2.1 mm)
Box	box weight	approx. 38 lb (17.5 kg)
	box dimensions	77 x 33 x 5 inches (1.96 x 0.83 x 0.13 m)
Reservoir	water capacity	27 gal (102 L)
Pump	pump capacity	12V DC marine pump, rated 500 gph at 2.0 amps. Output ranges from 0 to 250 mL/sec
Entire system	wt. of entire system (dry)	approx. 260 lbs (118.2 kg)
	wt. of entire system (wet, @25 gal)	approx. 460 lbs (209.1 kg)
	min. floor space required for demonstration with 12 people	12 x 15 ft (3.6 x 4.6 m)