Micro Hydro Survey

Basic Considerations

Understanding how much power you need will make designing your micro hydro project much easier. Start by filling out the "Energy Budget" spreadsheet to determine your needs.

Remember while planning your system that the drop in elevation, the flow through the pipe and the length of the pipe will determine the amount of power you can produce. In addition, the less water you use the better both for the environment and your plumber.

Please go through the following sections and fill out those that are appropriate to your site. From this information Energy Alternatives will be able to determine how much power you can generate and provide you with a quote on the cost of equipment for you micro hydro installation.

No Pipe or Dam Currently Installed

Intake – should be easily accessible to allow for easy maintenance
Powerhouse – should be placed to maximize drop in elevation

Specification	**Amount**	**Units**	**Notes**			
Change in elevation		ft				
Amount of Water Available		gpm				
Distance - Intake to Powerhouse		ft				
Diameter of Pipe		in				
Type of Pipe	Polyethylene	PVC	Copper	Concrete	Steel	Aluminium
Power Available		W	To be calculated by Energy Alternatives			

If you do not know the water flow at your site, use one of the following methods to determine it. Measure the flow at your site by doing a timed volume calculation, using the weir method or using the average cross section method. For more information on these methods see the supplementary material at the end of this survey.

Volume method		
Volume being used		gallons
Time required to fill		seconds
Weir Method		
Width of slot in weir		ft
Height of water above slot		in
Average Cross Section Method		
Average Depth of River		ft
Velocity		ft/s

Energy Alternatives can determine the size and type of pipe if you have determined how much power you need by filling out an Energy Budget. Otherwise you can choose the type and size of pipe that you feel would be appropriate for your stream. Polyethylene and PVC are the most common pipes used in micro hydro systems.

Pipe Currently in Place

If you already have a pipeline in place then your micro hydro setup will be much easier, however your current pipeline will dictate the amount of power that you can generate. The easiest way to measure these values is with a pressure gauge and a timed volume measurement. If you don't have access to a pressure gauge please fill in the table for "No Pipe or Dam Currently Installed."

Specification	Amount	Units	Notes
Pressure at Powerhouse		psi	
Flow at Powerhouse		gpm	
Power Available		W	To be calculated by Energy Alternatives

Other Considerations

Distance from the powerhouse to the place where you will use your electricity also makes a difference to the amount of electricity that you will have available. If possible, try to keep the powerhouse close to the end user to avoid electrical losses, but remember it easier to run electricity up hill than water.

Pre-Calculated Examples

No Pipeline

Specification	Amount	Units	Notes			
Change in elevation	30	ft				
Amount of Water Available	200	gpm				
Distance - Intake to Powerhouse	300	ft				
Diameter of Pipe	4	in				
Type of Pipe	Polyethylene	**PVC**	Copper	Concrete	Steel	Aluminium
Power Available	437.5	W	To be calculated by Energy Alternatives			

Pipeline in place

Specification	Amount	Units	Notes
Pressure at Powerhouse	64.9	psi	150 feet of elevation change
Flow at Powerhouse	30	gpm	5 gallon pail fills in 6 seconds
Power Available	100	W	To be calculated by Energy Alternatives

Typical Use Statistics

You can determine more accurately your typical personal use by using the Energy Alternatives "Energy Budget" Spreadsheet. The following table gives a rough estimate of how much electricity you need to be generating continuously to support these electrical devices.

100-150	W	Lights and Stereo
150-400	W	Appliances, Lights and Stereo
400-600	W	Shop Tools, Appliances, Lights and Stereo

Supplementary Material

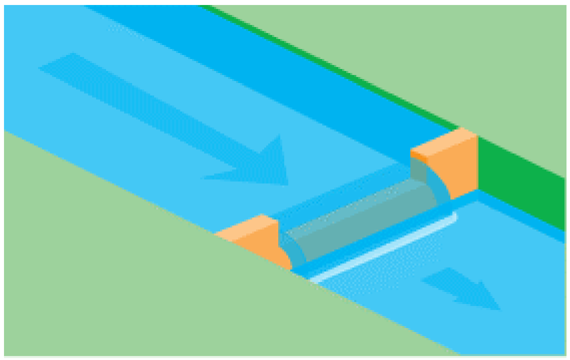
The Timed Volume Method

Use a bucket and a stopwatch to measure flow. Time the filling of a 5-gallon bucket. Calculate the gallons per minute by substituting your values of volume and time into the following example.

$$Flow\_Rate = \frac{Volume}{Time} = \frac{5gal}{47\sec} \times \frac{60\sec}{1\min} = 6.4gpm$$

The Weir Method

For systems that will use more than a few hundred gallons per minute second, particularly with low head systems such as the LH-1000 or the Powerpal, using the weir method will give good results.



Dam up the stream flow. Make an appropriate notch in the dam for the water to flow through. This is a weir.

By measuring the depth of water flowing over the notch, and knowing the size and shape of the notch, quite accurate measures of water volume are possible.

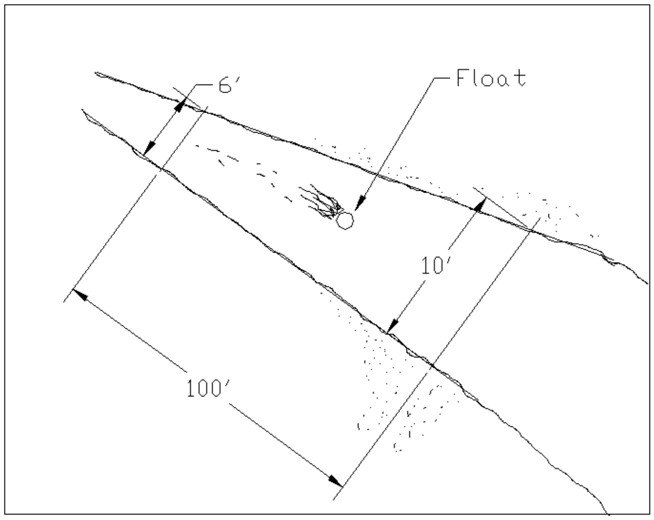
For example, the smallest Powerpal needs 500 US gpm. This would be 3 inches of water flowing over a rectangular 3-foot wide notch.

Weir table: Flow in US gpm over a rectangular weir of a given size

Inches of head	1 foot wide	3 feet wide	5 feet wide	Gpm/foot over 5 feet wide
1	35	107	179	36
1.5	64	197	329	66
2	98	302	506	102
2.5	136	421	705	142
3	178	552	926	187
4	269	845	1420	288
5	369	1174	1978	402
6	476	1534	2592	529
7	…	1922	3255	667

Average Cross Section Method

The flow rate of a stream or channel can be measured as shown in the figure below by timing a float.



Measure off a 50 – 100 foot section of the stream. Flow rate is equal to the cross sectional area times the velocity. Multiply the average cross-sectional area times the average stream velocity in fps (feet per second) to get the rate of flow is cfs (cubic feet per second).
Estimating the cross-sectional area if the hard part. A simple way to do it is to measure the bottom width of the channel and the top width, then average the two. Multiply this average times the depth of the water. Measure the widths and depth in fractions of feet (for example 1 foot 6 inches = 1.5 feet)

Example

A creek is 6 feet wide at the top and 10 feet wide at the bottom; the water is 3 feet deep. A float travels 100 feet in 33 seconds. This is our basic formula:
Flow rate = area x velocity x roughness factor

Area = average width x average depth
= (6+10)/2 x 3 = 24 ft^2

Velocity = Distance divided by time = 100/33 = 3 feet per second

Roughness factor = 0.8

Flow Rate = area x velocity x roughness factor
= 24 ft^2 x 3 feet per second x 0.8
= 58 ft^3 per second (rounded off)

Flow Rate = ft^3 per second x 448 = 26 000 gpm (rounded off)

Energy Budget

Understanding how much power you need will make designing your renewable energy project much easier. It will also give you an idea about what the big power consumers in your household are and point out places where you can reduce you energy consumption. It is cheaper and easier to conserve power then it is to produce it.

Before filling out the blank power budget sheet have a look at the example power budget to get an idea about how to fill out the sheet.

All cells that are outlined in gray are for you to fill in; Energy Alternatives will calculate those cells outlined in black.

12 VDC Appliances

A DC appliance is anything that runs directly off the battery and does not go through the inverter. If you are just starting your renewable energy system you may not have any items that run on dc power. In that case just leave this portion of the power budget blank.

120 VAC Appliances

An AC appliance is any appliance that can be plugged in to standard grid power. These appliances usually have on the back a small tag with serial number and power consumption information. More often then not the tag will not have the watts (W) that the unit consumes and instead has the amperage (A). You can calculate the watts by multiplying the amperage by 120 Volts.

$$Watts = Amps \times 120 Volts$$

Hours/Day and Days/Week, should be entered so that we can calculate how large a battery bank, inverter and solar array you will require.

It can be tough to find the information from every appliance in your household, so there is a sample power budget completed. This will give you the opportunity to use the values on that sheet *if* you cannot find the power consumption values on the your equipment.

W.hrs/Day

To fill in the W.hrs/Day column multiply the Watts that the appliance uses by the Hours/Day that you specified. If you total up this column for DC and AC separately and have this information ready when you phone Energy Alternatives (1-800-265-8898), we will be able to help you choose an appropriate solar battery system.

Priority

Fill in the column labeled priority if you need an inverter. Put a one in the priority column means that you want to be able to have these appliances on all at one time. If the appliance is one that you will use only once in a while then give this appliance a zero in the priority column. If you total up the Watts of the appliances that have a one in the priority column, this amount plus 15% for inefficiencies is the bare minimum size for your inverter.

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Project Name
Project Location
Contact

12 V Appliances

Qty	DC Powered Appliance	Priority	Wattage	Hours /Day	Days /Week	W.hrs /day

120VAC Appliances

Qty	Inverter Powered Appliance	Priority	Watts	Hours /Day	Days /Week	W.hrs /day

Project Name Sample Energy Budget
Project Location Victoria, BC, Canada
Contact Jeff Richards

12 V Appliances

Qty	DC Powered Appliance	Priority	Wattage	Hours /Day	Days /Week	W.hrs /Day
1	Inverter Standby	1	5	24	7	120
0	Sun Frost RF19 Frig/Freezer	1	96	10	7	0
0	Radio RX	1	4	24	7	0
0	Radio TX	1	50	1	7	0
1	Soldering Iron	0	25	0.1	2	2.5
4	Stereo	0	15	6	5	360
0	Ni-Cad Battery Charger	0	6	3	1	0
0	Lighting	1	26	5	5	0
0	Television	0	40	2	4	0
0	Electronic Fence	1	0.3	24	7	0
0	DC/DC Power Supply	0	10	2	3	0
0	Motor	0	70	0.5	7	0
0	Water Pump	1	48	12	7	0
0	Automatic Fan	1	24	3	4	0
0	Furnace	1	96	5	7	0
0	Propane Alarm	1	2.52	24	7	0
		DC Powered Appliances Total				482.5

120VAC Appliances

Qty	Inverter Powered Appliance	Priority	Watts	Hours /Day	Days /Week	W.hrs /day
1	19 cu ft Fridge/Freezer	1	120	10.00	7	1200.0
1	Well Pump 1/3 hp	1	850	1.25	7	1062.5
1	Computer Monitor	0	90	8.00	7	720.0
2	Television Sets	0	75	4.00	7	600.0
1	Solar DHW System	1	75	8.00	7	600.0
1	Mac G3 Computer	0	60	8.00	7	480.0
2	Stereos	1	25	9.00	7	450.0
6	Osram EL15R Fluorescents	1	15	5.00	7	450.0
1	HP Laserjet 4M Laser Printer	0	700	0.50	3	150.0
2	Video Cassette Recorders	0	40	4.00	7	320.0
1	Microwave Oven	0	800	0.25	7	200.0
1	Vacuum Cleaner	0	1350	0.50	2	192.9
1	Staber Washing Machine	0	200	1.25	2	71.4
1	HP FAX 350 Standby	1	5	24.00	7	120.0
1	Cordless Telephone	1	4	24.00	7	96.0
1	Power Tool	0	1350	0.20	2	77.1
0	Ni-Cad Battery Recharger	0	20	6.00	3	0.0
1	HP FAX350 FAX/Copier	0	40	1.00	5	28.6
1	Sewing Machine	0	80	5.00	1	28.6
1	Little Oscar Blender	0	350	0.05	7	17.5
1	Coffee Grinder	1	150	0.05	7	7.5
		AC Powered Appliances				6872.1