Canadian Hydrokinetic Turbine Test Centre
Safe Work Procedures

CHTTC
Canadian Hydrokinetic Turbine Test Centre

Last Revised: March 2017

Table of Contents

Marine Renewable Procedure – General CHTTC Site Activity

Purpose: As soon as anyone arrives at the CHTTC site, regardless of the planned activities, the following safety procedures and regulations must be followed.

Hazards:

Physical: Slipping, falling, drowning, strains and sprains
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: sun, wind, rain, snow, ice and extreme temperature

Personal protective equipment or safety equipment:

- At least 1 person on site must have a cellphone available for emergency situations
- Sunscreen, sunglasses and hat (optional)
- Insect repellent (optional)

Additional safety regulations:

- When operating within 2 meters (6.5 feet) from the shoreline personal flotation devices must be worn at all times, however, if the water temperature is below 10°C and the atmospheric temperature is below 10°C survival suits must be worn instead.

Education and training prerequisites:

- Knowledge and understanding of Canadian occupational health and safety (OH&S), Manitoba health and safety, *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* and *The Canadian Hydrokinetic Turbine Test Centre Safe Work Procedures*.

Steps to complete task safely:

1. Record your presence, the date, arrival time and purpose for being at the CHTTC site.
2. Ensure that the correct safety forms and checklists are completed prior to the beginning of any activities.
3. Ensure that the Great Falls Generating Station Control Room has been notified that activates are to be occurring at the CHTTC site. The contact is (204)-345-7121.
4. Ensure that all people at the site have signed a waiver indicating that they accept *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* and *The Canadian Hydrokinetic Turbine Test Centre Safe Work Procedures*.
5. Log and report any accidents or incidents that occur at the site.
6. Ensure that all items used during activities at the CHTTC are returned to their appropriate place in the storage or office sea-cans.
7. Ensure that the compound is locked up and sign out before leaving the CHTTC.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak –March 2017

Marine Renewable Procedure – Safe boating

Purpose: To safely operate any University of Manitoba owned watercraft or any watercraft at the CHTTC site, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 0^{+} crewmembers (1 person minimum)

Hazards:

Physical: Pinch points, sprains, strains, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Ensure that a watercraft inspection as per Section 6.4 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is performed prior to performing any operations using a watercraft.
- Never put your arm or fingers between the boat and mooring location.
- Never put your fingers inside the loop while tying a knot.

Education and training prerequisites:

- Ensure that watercraft operators meet the minimum criteria to operate a watercraft as per Section 6.5 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Understands how to tie half hitch and cleat hitch knots

Steps to complete task safely:

Boarding a watercraft from the shoreline

1. Signal the watercraft operator to approach the shoreline.
2. Alert the locations of possible hazards as the watercraft operator approaches the shoreline.
3. Have the watercraft operator position the watercraft in a location that minimizes boat motion and allows for a solid footing while boarding.
4. If possible, secure the boat by having one person on shore hold the painter.
5. Slowly and carefully step onto the watercraft. Once on the watercraft move to the back of the boat or take a seat and wait for the remaining people to board the watercraft.
6. Secure the painter back to the front of the watercraft and store extra line neatly on the watercraft.

General boating

1. Ensure that all equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is on the watercraft.
2. Arrange all gear to balance the load on the watercraft and ensure that the load does not exceed the capacity of the watercraft.
3. Secure loose lightweight gear that may shift during acceleration or from the wind.
4. Accelerate the watercraft in order to get on plane and then decelerate to a safe speed after the watercraft is on plane. Have all people on board look out for hazards.
5. Watch for obstacles in the watercraft and ensure that gear is not impeding movement.

6. Monitor the water depth using a sonar system (e.g. Humminbird 898c HD SI) to avoid damage to the watercraft.
7. Power turns may be required in order to safely turn the watercraft around in narrow channels.
8. Drive according to weather and environmental conditions.
9. If the boat engine becomes inoperable on the river, paddle downstream to the nearest safe point on shore at a pace that minimizes fatigue and strain. Report the incident to the CHTTC Watercraft Safety Officer.

Exiting a boat onto the shoreline

1. Spot and point out potential hazards as the boat driver approaches the shore.
2. Ensure that the location for dismounting allows for a solid footing during the dismount. Reposition the boat until such a location is discovered.
3. If possible, secure the boat by having a person on shore hold the painter.
4. Slowly are carefully step off the boat and onto land. Step away from the dismount location to allow others to dismount.
5. Ensure that the painter is secured onto the boat and remaining line is stored neatly in the front compartment.

Tying up a watercraft

1. Check that the mooring lines are free from any wear and tear and replace worn mooring lines.
2. Identify a minimum of two locations on the watercraft and mooring location at which to tie. For a side mooring operation, select locations at both the bow (front) and stern (back) of the watercraft.
3. Ensure the mooring location is secure and free of any sharp edges.
4. Move the watercraft into position.
5. Position fenders in between the watercraft and the mooring location.
6. Tie the watercraft to the mooring location using a secure half hitch or cleat hitch knot.
7. Turn off the watercraft engine.
8. Check that the knots are secure by pulling on the mooring line.
9. Ensure minimal movement when the watercraft is tied at all mooring locations. Re-tie the watercraft reduce the movement of the watercraft if necessary.

Responsibility completion and Review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Night boating

Purpose: To safely operate any watercraft at the CHTTC site at night or during periods of low light levels, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 2^{+} crewmembers (3 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- Searchlight or high powered flashlight
- Cellphone (in case of emergency)
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- In low visibility cases, all boarding of watercrafts must be done at designated docking locations and unknown shoreline areas are to be avoided.
- At least two people should be onboard the watercrafts at all times.
- Ensure that a watercraft inspection as per Section 6.4 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is performed prior to performing any operations using a watercraft.
- When tying a boat never put your arm or fingers between the boat and mooring location and never put your fingers inside the loop while tying a knot.
- Ensure that at least one non-participant is aware of the night boating activity and emergency plans have been reviewed.

Education and training prerequisites:

- Ensure that watercraft operators meet the minimum criteria to operate a watercraft as per Section 6.5 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Experience operating the boat during night or periods of low light levels
- Understands how to tie half hitch and cleat hitch knots

Steps to complete task safely:

1. Ensure that all equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is on the watercraft.
2. A non-participant must to be informed about the activity and emergency plans must be prepared and reviewed.
3. All potential hazards associated with the activity have to be discussed in meeting prior to the beginning of the activity.
4. Arrange all gear to balance the load on the watercraft and ensure that the load does not exceed the capacity of the watercraft. Ensure that all gear is arranged such as not to be a tripping hazard.
5. Secure loose lightweight gear that may shift during acceleration or from the wind.
6. The crewmembers should use the searchlights to light the left and right sides of the boat for the driver and warn the driver of any approaching objects or hazards.

7. When operating at the CHTTC, any available vehicles without a valid reason to do otherwise must shine their high beams on the anchor buoys located near the compound.
8. Accelerate the watercraft in order to get on plane and then decelerate to a safe speed after the watercraft is on plane. Have all people on board look out for hazards.
9. Watch for obstacles in the watercraft and ensure that gear is not impeding movement.
10. Monitor the water depth using a sonar system (e.g. Humminbird 898c HD SI) to avoid damage to the watercraft.
11. Power turns may be required in order to safely turn watercraft around in narrow channels.
12. Drive according to weather and environmental conditions.
13. If the boat engine becomes inoperable on the river, paddle downstream to the nearest safe point on shore at a pace that minimizes fatigue and strain. Report the incident to the CHTTC Watercraft Safety Officer.

Responsibility completion and Review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Launching and retrieving watercrafts

Purpose: To safely launch or retrieve any watercraft from a trailer, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 1^{+} crewmembers (2 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, crushing, cuts, bruising, slipping, falling, drowning, noise and impacts
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature and waves

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Ensure that a watercraft inspection as per Section 6.4 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is performed prior to performing any operations using a watercraft.
- Remember to complete a watercraft checklist during the launch process.

Education and training prerequisites:

- Ensure that watercraft operators meet the minimum criteria to operate a watercraft as per Section 6.5 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*

Equipment and tools required:

- Tie down straps
- Boat cover

Steps to complete task safely:

Launching a watercraft

1. The truck driver maneuvers the watercraft and trailer to the launch position. The crewmember should help direct the truck driver to the launch position.
2. For Zodiac boats, undo the tie down straps attaching the boat cover. Remove the boat cover by rolling it from back to front.
3. Perform visual inspection of the watercraft (condition of the hull, propeller and chambers).
4. Ensure that all drain plugs are properly installed and remove any motor mounts.
5. Put the safety equipment into the watercraft and attach a GPS and sonar unit to the watercraft.
6. Remove the tie down straps from the back of the watercraft.
7. For Zodiac boats, undo the safety chain at the front of the boat.
8. Provide slack to the winch strap.
9. Back the watercraft and trailer into the water. The watercraft operator uses hand signals to help guide the truck driver.
10. If the engine is not submerged drop the engine into the water until the foot is immersed.
11. Undo the winch strap, which is connecting the watercraft to the trailer.
12. Remove the trailer from the water.

Retrieving a watercraft

1. Provide slack to winch rope.
2. Back trailer into water until the bunks are submerged. The watercraft operator should help to direct the truck driver.
3. The watercraft operator slowly approaches the trailer and drives the watercraft onto the submerged bunks.
4. The watercraft operator attaches and tightens the winch strap to the boat.
5. On the watercraft operators' signal, the truck driver slowly and carefully drives the trailer and watercraft out of the water.
6. Ensure that all slack has been removed from the winch strap.
7. For Zodiac boats, connect the safety chain at the front of the boat.
8. Connect the safety straps to the back of the watercraft.
9. Remove any drain plugs and allow all water to drain out of the watercraft. When the water is finished draining replace all drain plugs.
10. Return all safety equipment to a secure location. Replace any lost of used safety equipment.
11. For storing Zodiac boats, unroll the boat cover and attach the cover to the boat using the tie down straps.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Off site watercraft measurements

Purpose: When CHTTC watercrafts are to be used in rivers or waters other than the Winnipeg River at or nearby the CHTTC site, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 1^{+} crewmembers (2 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, slipping, falling, drowning, noise, impacts and collisions
Biological: Dependant on the location of the trip
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Dependant on the location and time of the trip

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:

- Biological hazards are to be determined by Internet searches and communication with locals.
- Watercraft operator must comply with *Marine Renewable Procedure – Safe boating.*
- Crew members are to assist the watercraft operator in watching for river hazards.
- Measurements are to be conducted according to their respective *Marine Renewable Procedures.*

Education and training prerequisites:

- Education and training is dependant on the purpose of the trip and the measurements to be performed.

Equipment and tools required:

- Equipment and tools are dependent on the purpose of the trip and the measurements to be performed.

Steps to complete task safely:

1. Trip has to be planned and sent to the CHTTC Site Manager, CHTTC Watercraft Safety Officer and CHTTC Director for approval.
2. A minimum of two non-participants are to be informed about the trip and emergency plans must be prepared and reviewed.
3. Extensive research regarding the water system has to be collected through Internet searches and communication with locals.
4. All potential hazards associated with the trip have to be discussed in meetings prior to the trip.
5. Ensure that the blue water charts for the trip area are installed onto the Humminbird.
6. The watercraft must be shipped or transported to a pre-planned launch site. Ensure that all required equipment, tools and gear is also transported to the launch site.
7. The body of the watercraft has to be visually inspected for any unseen damages during transportation.
8. The weather forecast is to be observed for the entire duration of the trip.
9. The conditions of the water system and the challenges should be confirmed with locals if possible.
10. Ensure that all safety gear is inside the watercraft before departure.

Responsibility, completion and review

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health

concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Drilling anchor points

Purpose: To safety drill anchor points into any hard material the following safety procedures and regulations must be followed.

People: 1 drill operator, 1^{+} crewmembers (2 people minimum)

Hazards:

Physical: Electrocution, pinch points, cuts, crushing, strains, sprains, slipping, falling, dust, noise, burns and vibrating equipment

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: sun, wind, rain, snow, ice and extreme temperature

---

Personal protective equipment or safety equipment:

- Steel toe boots
- Safety glasses
- Disposable ear plugs
- Work gloves
- Dust mask or respirator (optional)

Additional safety regulations:

- The person operating the drill must weigh above 70 kilograms (155 pounds)
- When operating within 2 meters (6.5 feet) from the shoreline personal floatation devices must be worn at all times

---

Education and training prerequisites:

- Training on how to operate the drill under the supervision of experienced personnel.

Equipment and tools required:

- Drill and associated bits
- Threaded inserts and anchors
- Generator
- Crowbar, hammer, epoxy

Steps to complete task safely:

1. Perform an inspection of the electrical extension, generator, drill and anchors to identify any hazards or damaged equipment. Replace any damaged equipment.
2. Perform an inspection of the desired anchor location to identify any hazards.
3. Determine the optimal position for the anchor.
4. Transport a generator to the desired anchor location.
5. Place the generator as far away from the drilling location as possible to minimize exposure to exhaust fumes.
6. Ensure that the handle on the drill is tight.
7. Start the generator and run it for 5 minutes before plugging anything in, prior to drilling.
8. Position your leg against the drill to protect against the drill rotating and to help support your arms.
9. Stop drilling after every couple of minutes to allow the drill bit to cool down.
10. Remove all the dust from the hole that accumulated during the drilling process.
11. Insert the anchor into the hole. Ensure that the anchor fits tightly into the hole by applying epoxy if needed.
12. For eyebolt anchors, use a crowbar to tighten the eyebolt within the anchor.

Responsibility, completion and review:
Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Anchoring the blue pontoon

Purpose: To safely anchor the blue pontoon in high energy flows using shore anchors the following safety procedures and regulations must be followed.

People: 1 Zodiac operator, 1 blue pontoon operator, 2^{+} crewmembers (4 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- All watercraft operators must comply with *Marine Renewable Procedure – Safe boating.*
- Each watercraft should contain a minimum crew of two people.
- Prior to arriving at the anchoring location all crewmembers are to assist the watercraft operators in watching for hazards

Equipment and tools required:

- Pre-drilled round anchors located on the shoreline (recommended)
- Shackles
- Two large totes
- Steel cable (optional)

Steps to complete task safely:

Anchoring the blue pontoon to shore anchors

1. Ensure two winches are working and installed at the bow of the blue pontoon. Connect a controller to each winch.
2. Using the two front winches mounted on the blue pontoon, pay out enough rope to reach the shore on either sides of the channel. The ropes should be neatly coiled into two totes located directly behind the winches. Ensure two hook shackles are attached to the ends of the ropes.
3. Drive Zodiac boat and blue pontoon to the desired anchoring location.
4. Have the Zodiac crew perform an inspection of the area to determine any hazards and the safest path the reach the shoreline on both sides of the channel.
5. If pre-drilled anchors are available, have one person on the Zodiac leave the boat and attached shackles to the anchors on the shoreline to facilitate the anchoring process.
6. If pre-drilled anchors are not available, wrap steel cable around a secure structure such as a large rock or tree and attach a shackle to the steel cable. Ensure the structure is secure by pulling on the steel cable. The structure has now become an anchor.
7. Select the side of the blue pontoon to anchor first based upon the risks determined by the Zodiac crew. The side with increased risk should be done first.
8. Have the Zodiac drive up beside the blue pontoon on the selected side.
9. Pass the anchor cable underneath the guardrails on the blue pontoon to the personnel on the Zodiac.

10. The driver of the Zodiac then slowly moves across the channel to the shore where the anchor is on the same side of the channel. Look out for hazards such as submerged rocks while approaching the shore.
11. Once the Zodiac has reached the shore, the person with the winch cable will leave the boat, climb onto shore and attach the winch cable to the anchors.
12. The person will then re-board the Zodiac.
13. The winch operator will then pay in or out additional rope on the winch as needed.
14. Repeat steps 8-12 for the other side of the blue pontoon.

Detaching the blue pontoon from shore anchors

1. If the crew has changed since anchoring the blue pontoon, have the Zodiac crew perform an inspection of the area to determine any hazards and the safest path the reach the shoreline on both sides of the channel.
2. Select the side of the blue pontoon to detach first based upon the risks determined by the Zodiac crew. The side with increased risk should be done first.
3. The driver of the Zodiac then slowly moves across the channel to the shore where the anchor is on the selected side of the channel. Look out for hazards such as submerged rocks while approaching the shore.
4. Once the Zodiac has reached the shore, the person with the winch cable will leave the boat, climb onto shore and detach the winch cable from the anchors.
5. The person then throws the hook anchor and winch cable into the water upstream of the blue pontoon and Zodiac boat.
6. The person then throws the anchor into the water upstream of the blue pontoon. The person will then re-board the Zodiac.
7. One or two people then pull the rope into onto the blue pontoon and into one of the totes as fast as they can. Be extremely careful to not allow the winch rope to get caught in any watercraft propellers.
8. Repeat steps 3-7 for the other side of the blue pontoon.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Zodiac surface measurements

Purpose: To perform ADV or ADCP measurements with the measurement arm on the Zodiac the following safety procedures and regulations must be followed.

People: 1 Zodiac operator, 2 measurement arm operators, 1 computer operator, (4 people optimal)

Hazards:

Physical: Pinch points, sprains, strains, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:

- Zodiac operator must comply with *Marine Renewable Procedure – Safe boating.*
- Mount operators are to assist the Zodiac operator in watching for river hazards.
- The Zodiac must remain stationary when the ADV or ADCP is in the water unless the measurements require a moving vessel.
- The maximum depth for the vertical ADCP should not exceed ½ meter (1.5 feet). .

Education and training prerequisites:

- Training on how to use the measurement arm.
- Computer operator must be knowledgeable and efficient with the ADV or ADCP measurement software.

Equipment and tools required:

- Laptop (Toughbook recommended)
- ADV or ADCP and all associated cables, clamps, adapters and/or mounts
- Invertor or generator
- Zip ties

Steps to complete task safely:

Set-up for ADV measurements

1. Attach the ADV to the mount while the boat is docked and the measurement arm is in a horizontal position and is resting on the support.
2. Attach a rope line around the base of an ADV clamp so that it is easier to bring the arm up after a measurement is completed and to ensure that the ADV is not lost.
3. Check that all bolts are tight and that the ADV is secure.
4. Adjust the length of the arm to the appropriate depth for the measurements.
5. Check that all bolts on the measurement arm are tightened and that the mechanical stopper is engaged so that the measurement pole does not rotate or slip.
6. Connect the data cable to the ADV and zip tie the cable at a minimum of two points along the arm.
7. Connect the power cord to the ADV cable and plug it into a power source (preferably an inverter connected to the boat battery).
8. Set up the computer (preferably a Toughbook) and connect the ADV cable carefully to ensure that the

connector pins are not damaged.

Set-up for vertical ADCP measurements

1. Attach the ADCP to the mount while the boat is docked and the measurement arm is in a horizontal position and is resting on the support.
2. Attach a rope line around one of the measurement pole so that it is easier to bring the arm up after a measurement is completed.
3. Check that all bolts are tight and that the ADCP is secure.
4. Adjust the length of the arm to the appropriate depth for the measurements.
5. Check that all bolts on the measurement arm are tightened and that the mechanical stopper is engaged so that the measurement pole does not rotate or slip.
6. Connect data cable to the ADCP and zip tie the cable at a minimum of two points along the arm.
7. Connect the power cord to the ADCP cable and to a power source (preferably an inverter connected to the boat battery).
8. Set up the computer (preferably a Toughbook) and connect the ADCP cable carefully to ensure that the connector pins are not damaged.

Set-up for HADCP measurements

1. Attach the HADCP to the mount while the boat is docked and the measurement arm is in a horizontal position and is resting on the support.
2. Attach a rope line around one of the measurement pole so that it is easier to bring the arm up after a measurement is completed.
3. Check that all bolts are tight and that the HADCP is secure.
4. Adjust the length of the arm to the appropriate length for the measurements.
5. Check that all bolts on the measurement arm are tightened and that the mechanical stopper is engaged so that the measurement pole does not rotate or slip.
6. Zip tie the HADCP cable at a minimum of two points along the arm.
7. Connect the HADCP cable and to a power source.
8. Set up the computer (preferably a Toughbook) and connect the HADCP cable carefully to ensure that the connector pins are not damaged.

Data collection procedure

1. Open the device software.
2. Using the Humminbird blue water chart and pre-specified waypoints locate a measurement point and drive the Zodiac to it.
3. Drive through the region, using sonar (e.g. Humminbird 898c HD SI) to examine the depth and potential hazards such as shallow areas.
4. Extend the arm over the water and rotate the measurement arm such that it is perpendicular to the water surface and the device is submerged. If a pole is being used to rotate the arm, ensure that all personnel on the boat are clear of the pole.
5. Lock the arm in place.
6. Begin taking measurements.
7. For stationary measurements, the boat driver locates a landmark on shore and attempts to hold the boat steady throughout measurement. For moving measurements, the mount operators must help the boat driver look for hazards.
8. While the measurement is taking place, the computer operator records the file ID, the date of the measurement, the start time, the approximate duration of the measurement, the water depth (taken from the sonar) and anything else that may be of interest when post-processing or examining the data.
9. Once the measurement is complete, stop the measurement on the computer and bring the arm back into the boat.
10. Once the arm is back on the boat, the boat driver can move to the next location. Repeat steps 3 to 10 for each new measurement.

Responsibility, completion and review

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Blue pontoon surface measurements

Purpose: To perform measurements using an ADV, ADCP or HADCP from the blue pontoon using the measurement arm or other surface mounts the following safety procedures and regulations must be followed.

People: 1 Blue pontoon operator, 3^{+} crewmembers (4 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:

- Zodiac operator must comply with *Marine Renewable Procedure – Safe boating.*
- Mount operators are to assist the Zodiac operator in watching for river hazards.
- The Zodiac must remain stationary when the ADV or ADCP is in the water unless the measurements require a moving vessel.
- The maximum depth for the ADCP should not exceed ½ meter (1.5 feet).

Education and training prerequisites:

- Training on how to use the measurement arm.
- Computer operator must be knowledgeable and efficient with the ADV or ADCP measurement software

---

Equipment and tools required:

- Laptop (Toughbook recommended)
- ADV or ADCP and all associated cables, clamps, adapters and/or mounts
- Invertor or generator
- Zip ties

Steps to complete task safely:
Set-up for ADV measurements using the measurement arm

1. Attach the ADV to the mount while the blue pontoon is docked and the measurement arm is in a horizontal position and resting on the support.
2. Check that all bolts are tight and that the ADV is secure.
3. Adjust the length of the arm to the appropriate length for the measurements.
4. Check that all bolts on the measurement arm are tightened so that the measurement pole does not rotate or slip.
5. Connect the data cable to the ADV and zip tie the cable at a minimum of two points along the arm.
6. Connect the power cord to the ADV cable and plug it into a power source (preferably an inverter connected to a battery).

7. Set up the computer (preferably a Toughbook) and connect it to the ADV carefully to ensure that the connector pins are not damaged.

Set-up for vertical ADCP measurements using the measurement arm

1. Attach the ADCP to the mount while the boat is docked and the measurement arm is in a horizontal position and resting on the support.
2. Check that all bolts are tight and that the ADCP is secure.
3. Adjust the length of the arm to the appropriate length for the measurements.
4. Check that all bolts on the measurement arm are tightened so that the measurement pole does not rotate or slip.
5. Connect data cable to the ADCP and zip tie the cable at a minimum of two points along the arm.
6. Connect the power cord to the ADCP cable and to a power source (preferably an inverter connected to a battery).
7. Set up the computer (preferably a Toughbook) and connect it to the ADCP carefully to ensure that the connector pins are not damaged.

Set-up for HADCP measurements using the measurement arm

1. Attach the HADCP to the mount while the boat is docked and the measurement arm is in a horizontal position and resting on the support.
2. Check that all bolts are tight and that the HADCP is secure.
3. Adjust the length of the arm to the appropriate length for the measurements.
4. Check that all bolts on the measurement arm are tightened so that the measurement pole does not rotate or slip.
5. Zip tie the HADCP cable at a minimum of two points along the arm.
6. Connect the HADCP cable and to a power source.
7. Set up the computer (preferably a Toughbook) and connect it to the HADCP carefully to ensure that the connector pins are not damaged.

Measurement arm data collection

1. [Optional] – Anchor the blue pontoon according to *Marine Renewable Procedure – Anchoring the blue pontoon.*
2. Open the device software.
3. Using the Humminbird blue water chart and pre-specified waypoints locate a measurement point and drive to it. Check the depth of the measurement location.
4. Rotate the pole to a vertical position using the hand crank provided.
5. Lock the measurement arm in place using the stopper.
6. Begin taking measurements.
7. If the blue pontoon is not anchored during stationary measurements, the boat driver locates a landmark on shore and attempts to hold the boat steady throughout measurement. For moving measurements, the mount operators must help the boat driver look for hazards.
8. While the measurement is taking place, the computer operator records the file ID, the date of the measurement, the start time, the approximate duration of the measurement, the water depth (taken from the sonar) and anything else that may be of interest when post-processing or examining the data.
9. Once the measurement is complete, stop the measurement on the computer and bring the arm back to the horizontal position.
10. Once the arm is back in the horizontal position, the boat driver can move to the next location.

Set-up and measurement procedure for ADCP, HADCP and ADV bolted to the guardrails

1. Wrap protective rubber around the measurement device.
2. Hose clamp the measurement device to the U channel around the previously placed protective rubber.
3. Plug the data cable into the measurement instrument.
4. Using metal plates and ½ inch bolts, bolt the U channel to the blue pontoon guardrail. Ensure that the measurement instrument is oriented properly in the flow.

5. [Optional] – Anchor the blue pontoon according to *Marine Renewable Procedure – Anchoring the blue pontoon.*
6. Open the device software.
7. Using the Humminbird blue water chart and pre-specified waypoints locate a measurement point and drive to it.
8. Connect the measurement device to a power source.
9. Set up the computer (preferably a Toughbook) and connect it to the measurement device carefully to ensure that the connector pins are not damaged.
10. Begin taking measurements.
11. Once completed return to shore before unbolting the measurement instrument from the blue pontoon.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Profile measurements

Purpose: To perform profile measurements using the blue pontoon with an ADV the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 1 computer operator and 2^{+} crew members (4 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, cuts, scrapes, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust, battery acid and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- The blue pontoon must be anchored according to *Marine Renewable Procedure – Anchoring the blue pontoon* during all profile measurements.

Education and training prerequisites:

- Computer operator must be knowledgeable and efficient with the ADV software

---

Equipment and tools required:

- Laptop (Toughbook recommended)
- ADV and all associated cables, clamps, adapters and mounts
- Invertor or generator
- Zip ties, wire cutters and needle nose pliers

Steps to complete task safely:

1. While the blue pontoon is docked, attach the winch pole to the mount in the center of the blue pontoon and ensure the pole extends over the removable hatches in the blue pontoon floor.
2. Thread the steel cable through the winch using the controller to reel the cable in. Ensure that the cable is long enough for your application; this includes the depth of the area, the bending of the wire cable due to drag from the water flow, the distance from the water surface to the top of the winch pole and finally the distance from the tip of the winch pole back to the winch.
3. Attach a steel stopper to the bottom of the cable, about ½ meter (1.5 feet) from the end of the cable.
4. If the measurement unit is not assembled, assemble the measurement unit and attach it to the winch cable.
5. Crimp or tie the end of the winch cable to allow for connection to anchor blocks. To form the anchor blocks attach together two or three heavy weights that will weigh down the cable enough to bring it to the bottom of the channel. Use a clip to attach them together, but have a belt attached to the clip to make them easier to lift.
6. Attach the weights to the bottom of the cable, pick up the weights using the belt and lower them into the water. Do not allow the winch to feed out. Do this by clipping the belt to the blue pontoon grate flooring.
7. Deploy the blue pontoon according to *Marine Renewable Procedure – Anchoring the blue pontoon.*
8. Ensure the blue pontoon remains centered laterally using the winches.
9. Attach the ADV to the measurement unit. Do this by placing the ADV in the clamps. If the ADV is too small,

place a piece of rubber or plastic underneath the ADV in the location of the clamps. Tighten the clamps such that the ADV is being held tightly. Attach a safety rope between the ADV hose clamp and the measurement unit to ensure that the ADV can be saved, even if the clamps release.

10. Attach a second safety rope through one of the cross bars on the ADV measurement unit and to the railings of the blue pontoon. This is to ensure that the ADV does not hit the central opening of the blue pontoon.
11. Attach a rope to the ADV measurement unit. Do this by attaching a clip to the top of the unit and tying the safety rope to it. Then, tie the safety rope onto the winch pole. This will stop it from moving.
12. Connect the data cable and power cable to the ADV (preferably an inverter connected to the boat battery). Ensure the data cable is long enough for the application, including all of the same considerations as the winch cable in step 2.
13. Once prepared, the weights can be released and allow the cable to fall and slowly pay out the winch until the weights hit bottom. It is possible to identify when the weights hit bottom by feeling the tension on the cable.
14. Once the weights have hit the bottom, move the blue pontoon downstream by paying out both the front winches. This is to reduce the angle of the measurement cable. Ensure that the weights do not lift off the bottom during the operation.
15. Once the blue pontoon has moved backwards sufficiently, there will be slack on the measurement cable and it will be able to be brought in with the winch. Bring the cable in only until you just cannot feel the slack when pulling the cable. This is to reduce the bending of the cable, and subsequently, the angle of the ADV.
16. Remove the safety rope from the ADV measurement unit.
17. Set up a computer (preferably a Toughbook) and connect it to the ADV carefully to ensure that the connector pins are not damaged.
18. Using the safety cable, slowly lower the ADV unit into the water. Using the ADV software, observe the pressure reading from the ADV. You can use this as an approximate depth in meters.
19. [Optional] – Set-up the sonar camera according to *Marine Renewable Procedure – Sonar camera recording* and verify that the weights have not lifted up from the bottom by the increased drag on the system caused by the unit being submerged. Bring the cable out to lower the weights if necessary.
20. Begin taking measurements at desired depths.
21. Zip tie the data cable to the safety rope attached to the ADV to ensure that the cables do not tangle underwater. Use a different color zip-tie for the first attachment point.
22. When all measurements have been completed, bring the ADV back to towards the surface using the safety rope. When the different color zip tie appears at the surface this indicates that the ADV is about to surface. Carefully extract the ADV from the water and tie the safety rope on the winch pole.
23. Using the winch controller, bring in the winch cable and the anchor blocks. Ensure the anchor cable does not get tangled in the winch. Using the belt, bring the anchors back into the boat, or clip the belt to the grate flooring and bring them in once you have returned to shore.
24. Detach the blue pontoon as per *Marine Renewable Procedure – Blue pontoon deployment.*

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Bathymetry recording

Purpose: To perform a recording of the bathymetry of a site using a Humminbird 898c HD SI the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 1^{+} crewmembers (2 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- Humminbird 898c HD SI with blue water charts installed
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Watercraft operator must comply with *Marine Renewable Procedure – Safe boating*

Education and training prerequisites:

- At least one crewmember should be knowledgeable on to operate the Humminbird 898c HD SI and perform recordings

---

Equipment and tools required

- Humminbird monitor, depth sounder, GPS puck and SD card
- 12 volt battery
- Piece of plywood, screws and corresponding screwdriver [Generic boat only]

Steps to complete task safely:

1. For non-CHTTC watercrafts, devise a method of securing the depth sounder to the boat. For a generic boat this is usually done by screwing the depth sounder mount to a piece of wood, attaching the depth sounder to the mount and clamping the piece of wood to the back of the boat.
2. Attach the Humminbird GPS puck, the power cable and the depth sounder to the Humminbird monitor.
3. Connect the power cable to a 12 volt battery.
4. Insert the SD card into the Humminbird monitor and turn on the display.
5. Confirm that the Humminbird depth sounder and the Humminbird GPS puck are working by viewing the output on the monitor.
6. Perform an initial survey of the area to determine the areas of interest for performing a recording.
7. Switch views to the recording screen by pressing the View (forward a screen) or Exit (backwards a screen) buttons.
8. Once on the recording screen press the Menu button and select start recording by hitting the Down direction button until the start recording option is reached. Then press the Right directional button. Note the recording number of the file.
9. Drive the boat slowly over the desired area, preferably for a minimum of one hour. Try to create as fine of a grid as possible with the boat. Try to maximize the resolution in areas of high depth gradients.
10. Ensure that one recording provides the parameter of the measurement area in detail. This will significantly improve the quality of the data and the amount of post-processing required later.

11. Once the data is collected, press the Menu button on the Humminbird monitor and then press the Right directional button to stop the recording.
12. Once on shore, turn off the Humminbird monitor and disassemble the depth sounder mount. Return all components to the box.
13. [Optional] – To export the data, remove the SD card from the Humminbird monitor and insert the SD card into a computer and load the HumViewer software. The HumViewer software is available as a free download. Open the file with the recording number, noted previously in step 8, and select the export tab. Export the data as a kml file with a filename of your choosing. The kml file is ready for further post-processing.

Responsibility, completion and review

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Current meter measurements

Purpose: To perform short-term or long-term measurements using the current meter, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 2^{+} crewmembers (3 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, cuts, scrapes, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Watercraft operators must comply with *Marine Renewable Procedure – Safe boating.*
- The blue pontoon must be anchored according to *Marine Renewable Procedure – Anchoring the blue pontoon* during all current meter measurements through the central hatch.
- For measurements performed using the blue pontoon, plywood sheets are to be positioned on the blue pontoon grating in areas that require kneeling, sitting or lying.

Education and training prerequisites:

- Computer operator must be knowledgeable with performing live measurements and deployments.

Equipment and tools required:

- Laptop (Toughbook recommended)
- Current meter, all associated cables and dummy plugs
- Shackles, pulley, rope

Steps to complete task safely:

Deployment though the central hatch of the blue pontoon

1. Anchor the blue pontoon according to *Marine Renewable Procedure – Anchoring the blue pontoon*.
2. Attach the current meter to the steel cable line on the central winch on the blue pontoon. Ensure that the current meter is oriented in the direction of the flow.
3. Attach an Amsteel blue safety rope to the current meter ensuring that the steel winch line and safety ropes are connected to two separate points on the instrument.
4. For autonomous deployments, connect the current meter to a computer (preferably a Toughbook), set-up the deployment and check the status of the internal memory and battery. When completed, insert a dummy plug into the current meter.
5. For a live deployment, connect the current meter to a computer (preferably a Toughbook).
6. Using the central winch on the blue pontoon, slowly lower the current meter until it is just above the surface of the water. Hold onto the instrument to minimize any swaying of the instrument.
7. [Optional] – Attach a come-along pulley to the winch cable just above the current meter. Using a rope secure the pulley in place by attaching it to the grating of the blue pontoon.
8. Submerge the current meter to the desired depth using the winch.
9. Perform the desired flow measurements.

10. Slowly lift the current meter using the winch attached to the blue pontoon until the device surfaces just above the level of the water. One person should be lying or kneeling near the central hatch to ensure that the current meter does not hit the blue pontoon while emerging from the water.
11. If the come-along pulley in step 7 was used, remove the come-along pulley attached to the blue pontoon grating.
12. Slowly winch the current meter onto the blue pontoon and disconnect the current meter from the winch. Additionally, disconnect the safety line.
13. For a live deployment, the instrument can be disconnected from the computer and the data cable can be removed from the instrument.

Deployment using a buoy

1. Retrieve a buoy according to *Marine Renewable Procedure – Retrieving and replacing buoys*.
2. Attach the current meter using wire or Amsteel blue rope to a shackle connected to the buoy. Ensure that the current meter is oriented in the direction of the flow.
3. Attach a safety rope to the current meter. Ensure that the safety rope is connected to a separate location on the instrument.
4. For autonomous deployments, connect the current meter to a computer, set-up the deployment and check the status of the internal memory and battery. When completed, insert a dummy plug into the current meter.
5. For a live deployment, connect the current meter to a computer.
6. Release the buoy and current carefully back into the flow.
7. Perform the desired measurements.
8. Retrieve the buoy and current meter according to *Marine Renewable Procedure – Retrieving and replacing buoys*.

Responsibility completion and Review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Sonar camera recording

Purpose: To perform a sonar camera recording using the Zodiac measurement arm, the following safety procedures and regulations must be followed.

People: 1 Zodiac boat operator, 2^{+} crewmembers (3 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Crewmembers are to assist the driver in watching the river for hazards
- Boat must remain stationary when the sonar camera is in the water unless the recording requires a moving vessel. The boat must operate at slow speeds only.

Education and training prerequisites:

- Training on how to use the Zodiac measurement arm.
- Training on how to assemble the sonar camera using both the motorized mount and fixed metal mount.
- Computer operator must be knowledgeable and efficient with the sonar camera recording software.

Equipment and tools required:

- Sonar camera and hardware
- Either the motorized mount or the fixed metal mount (application dependent)
- Tool bag containing screwdrivers and wrenches

Steps to complete task safely:

Assembly of fixed mount

1. Connect the sonar camera adapter to the Zodiac measurement arm when the arm is in a horizontal position supported on the resting arm.
2. Align and attach the adapter such that the angles are facing away from the Zodiac.
3. Attach the sonar camera to the metal mount and then attach the metal mount to the adapter on the Zodiac measurement arm. There are multiple angles to select from. Select the angle based upon your application.

Assembly of motorized mount

1. Assemble the motorized mount according the instructions provided with the sonar camera. Ensure that all cables are properly connected.
2. Connect the assembled motorized mount to the end of the Zodiac arm when the arm is in a horizontal position supported by the resting arm.

Sonar camera measurements

1. Attach a safety rope to the Zodiac measurement arm.

2. Connect all power cables and data cables to a computer (preferably a Toughbook) and the sonar device. Refer to the sonar camera user manual as required.
3. Drive the Zodiac to the recording location.
4. Loosen the bolts on the green clamps at the back of the Zodiac boat, and extend the arm over the water and rotate the measurement arm such that it is perpendicular to the water surface and the device is submerged. If a pole is being used to rotate the arm, ensure that all personnel on the boat are clear of the pole.
5. Tighten the bolts on the green clamps at the back of the Zodiac. Put the stopper in place.
6. Perform the sonar camera recording.
7. Loosen the bolts on the green clamps at the back of the boat and remove the stopper.
8. Use safety cable to bring the depth pole back to a position parallel to the water surface.
9. Slide the measurement arm back inside the boat if no additional measurements are to be performed. For additional measurements, leave the measurement arm over the water surface but tie the safety rope to the pole rest and drive the Zodiac to the next measurement location. Then rotate the measurement arm such that it is perpendicular to the water surface and the device is submerged. If a pole is being used to rotate the arm, ensure that all personnel on the boat are clear of the pole. Repeat steps 8-12.
10. Tighten the bolts and put the stopper back in.
11. Return to shore and remove the sonar and adapter from the Zodiac pole.

Responsibility completion and Review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Shear probe recording

Purpose: To perform a measurement using the shear probe the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 2^{+} crewmembers (3 people required)

Hazards:

Physical: Pinch points, sprains, strains, slipping, falling, rope abrasion, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:

- Ensure that a watercraft inspection as per Section 6.4 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations* is performed prior to performing any operations using a watercraft.

Education and training prerequisites

- Ensure that watercraft operators meet the minimum criteria to operate a watercraft as per Section 6.5 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*

Equipment and tools required:

- Rope and measuring tape
- Sonar (e.g. Humminbird 898c HD SI).

Steps to complete task safely:

Shear probe set-up

1. To prevent damage to the shear probe, if possible, perform the set-up of the shear probe on shore.
2. Remove the shear probe from its transport case.
3. Remove the dummy plugs from the bottom of the shear probe. Carefully replace the dummy plugs with the shear and temperature sensors.
4. Tighten all sensors with the supplied circular key.
5. Place the feet on the bottom of the shear probe.
6. Determine the depth of the measurement location using sonar (e.g. Humminbird 898c HD SI).
7. Measure a piece of rope approximately as long as the depth, then subtract ½ meter (1.5 feet) from this length.
8. Tie one end of the rope to the shear probe and tie a knot at the other end.

Shear probe measurement

1. Transport the shear probe carefully to the watercraft. Ensure that the probes are not damaged during transport.
2. Drive the watercraft to the measurement location and perform a visual inspection of the measurement location to ensure that the area is safe.

3. Verify that the depth of the location matches the amount of rope tied to the shear probe plus ½ meter (1.5 feet).
4. Have the watercraft operator remain stationary at the measurement location.
5. Turn on the shear probe by screwing in the magnet at the bottom of the probe.
6. Have two crewmembers transport the shear probe to the front of the watercraft and lift the shear probe over the front edge of the watercraft.
7. The watercraft operator cuts the power to the boat engine and allows the boat to drift with the flow.
8. The crewmembers are to release the shear probe into the water and pay out the rope tied to it.
9. Once the knot on the loose end of the rope has reached the crewmembers, the crewmembers are to pull the shear probe up using the rope and bring it into the watercraft.
10. The boat driver can now power the boat once again.
11. [Optional] – Remove the magnet from the shear probe. This will create a new file in the shear probe for the next recording; otherwise all profiles will be recorded in a single file.
12. Repeat steps 2 to 11 for all additional measurement points. The length of rope may have to be adjusted depending on the depths.
13. Remove magnet from the shear probe to turn the instrument off.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Outdoor grinding

Purpose: To safely perform any grinding operations outdoors the following safety procedures and regulations must be followed.

People: 1 grinder operator, 1^{+} crewmembers (2 people minimum)

Hazards:

Physical: Cuts, scrapes, slipping, falling, metal shards, noise and burns
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: sun, wind, rain, snow, ice and extreme temperature

---

Personal protective equipment or safety equipment:

- Work gloves protecting the arms
- Safety glasses or face shield
- Long sleeves (optional)
- Ear plugs or mufflers (optional)
- Steel toe boots (optional)

Additional safety regulations:

- Crewmembers are only required for safety in case of an emergency.
- When operating within 2 meters (6.5 feet) from the shoreline personal floatation devices must be worn at all times

---

Education and training prerequisites:

- Training on how to use the grinder

Equipment and tools required:

- Grinder and extra grinder blades
- Generator

Steps to complete task safely:

1. Ensure the grinder blade is securely attached to the grinder, is held tight and is not worn down.
2. Bring the generator and grinder with extra blades to the grinding location.
3. Examine the grinding area to determine the most ergonomic position and any potential hazards.
4. Start the generator and place it as far away as practically possible from the grinding point. Let the generator run for 5 minutes without load prior to performing any grinding.
5. Turn on the grinder.
6. When grinding, ensure that the blade is always rotating away from the user. Be aware of flying metal and sparks.
7. Turn off the grinder and examine the blade to determine if a replacement blade is required.

Responsibility, completion and review

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Launching and retrieving trailered turbines

Purpose: To safely launch or retrieve any turbine from a trailer, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 1^{+} crewmembers (2 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, crushing, cuts, bruising, slipping, falling, drowning, noise and impacts
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature and waves

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- The Zodiac operators must comply with *Marine Renewable Procedure – Safe boating.*
- Ensure the turbine is functional and buoyant before performing the deployment.
- Prior to pushing any turbine with a Zodiac onto the trailer, check the turbine for any sharp edges that may puncture the Zodiac pontoons.

Education and training prerequisites

- Ensure that watercraft operators meet the minimum criteria to operate a watercraft as per Section 6.5 in *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*

Equipment and tools required:

- Tie down straps and rope

Steps to complete task safely

Launching a turbine

1. The truck driver maneuvers the turbine and trailer to the launch position. The crewmember should help direct the truck driver to the launch position.
2. Perform visual inspection of the turbine to inspect for any damage that may have occurred during transport.
3. Launch the turbine by slowly backing the turbine and trailer into the water. Before the trailer is completely submerged, release all tie down lines from the trailer allowing the turbine to float.
4. If the current is strong enough to push the turbine, secure the turbine to shore with a mooring line.
5. Remove the trailer from the water.

Retrieving a turbine

1. As per either *Marine Renewable Procedure – Manned turbine retrieval* or *Marine Renewable Procedure – Manless turbine retrieve* manoeuvre the turbine to the extraction site.

2. Back trailer into water until the trailer is submerged. A Zodiac operator should help to direct the truck driver.
3. If a Zodiac is attached to the turbine guide the turbine onto the trailer.
4. If no Zodiacs are attached to the turbine, it may be possible to push the turbine onto the trailer. If not, have the Zodiac get close the turbine's pontoon and attach the Zodiac from two points to the pontoon. The rear rope should take the bulk of the load and the front rope should be used to secure the Zodiac nose to the turbine's pontoon. Guide the turbine onto the trailer.
5. Detach any Zodiac boats from the turbine. If the current is strong enough to push the turbine, secure the turbine to shore with a mooring line.
6. Prior to removing the trailer completely from the water attach all tie down lines to the trailer securing the turbine for transport.
7. Remove the turbine and trailer from the water.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Excavator deployments

Purpose: To perform the deployment of watercrafts, turbines and/or any sort of floatable structures from the shore to the water the following safety procedures and regulations must be followed.

People: 1 excavator operator, 2^{+} crewmembers (3 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, crushing, cuts, bruising, slipping, falling, drowning, noise and impacts
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature and waves

---

Personal protective equipment or safety equipment:

- Personal floatation device
- Steel toe boots, hard hats and reflective vests
- Work gloves (optional)

Additional safety regulations:

- When operating within 2 meters (6.5 feet) from the shoreline personal floatation devices must be worn at all times
- Inspect all objects to be deployed for damage prior to performing *Marine Renewable Procedure – Excavator deployment* for damage.

Education and training prerequisites:

- Excavator operator must be a trained and hired professional. No CHTTC or University of Manitoba members will operate the excavator.

Equipment and tools required:

- Shackles
- Slings, short strap and rope

Steps to complete task safely:

1. Inspect the slings and shackles for wear and tear and make sure that the lifting capacity is sufficient for the activity.
2. Attach four same size slings to four points on the unit. The length of each sling must be long enough to clear the highest point of the unit. The four points are selected in such a way as the weight is balanced between the four slings, reducing swaying.
3. In the case that different sized slings are used, choking and knot tying techniques are prohibited.
4. The excavator arm must reach the center and top of the unit. A short length strap must go around the excavator arm to prevent the slings from rubbing against the excavator.
5. The four slings are hooked to the strap using shackles. Two ropes are attached to either the front or back corners to control the sway when the excavator lifts the unit.
6. Attach an anchor rope to the unit. The rope will be used to secure the unit to the shore.
7. Lift slowly using the excavator and check if the unit is balanced.
8. Two people are assigned to control the unit using the ropes during the lifting operation. One person is assigned to each rope.
9. The unit is lifted and moved to the launching point.
10. The unit is dropped into the water using the excavator and one rope. When the unit is being dropped into the water, the furthest guide rope has to provide slack to the rope.

11. Secure the unit to the shore using the attached anchor rope.
12. One person must board the unit and must open the shackles to release the slings and bring the slings back to the shore.

Responsibility, completion and review:
Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak March 2017

Marine Renewable Procedure – Excavator retrieval

Purpose: To perform the retrieval of watercrafts, turbines or any sort of floatable structures from the water to the shore the following safety procedures and regulations must be followed.

People: 1 excavator operator, 2^{+} crewmembers (3 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, crushing, cuts, bruising, slipping, falling, drowning, noise and impacts
Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature and waves

---

Personal protective equipment or safety equipment:

- Personal floatation device
- Steel toe boots, hard hats and reflective vests
- Work gloves (optional)

Additional safety regulations:

- When operating within 2 meters (6.5 feet) from the shoreline personal floatation devices must be worn at all times

---

Education and training prerequisites:

- Excavator operator must be a trained and hired professional. No CHTTC members will operate the excavator.

Equipment and tools required:

- Shackles
- Slings, short strap and rope

Steps to complete task safely:

1. Inspect the slings and shackles for wear and tear and make sure that the lifting capacity is sufficient for the activity.
2. One or two people must board the unit and must attach four same sized slings to four points on the unit. The length of each sling must be long enough to clear the highest point of the unit. The four points are selected in such a way as the weight is balanced between the four slings to reduce swaying.
3. Excavator arm must reach the center and top of the unit. A short length strap must go around the excavator arm to prevent the slings from rubbing against the excavator.
4. The four slings are hooked to the strap using shackles. Two ropes are attached to either the front or back corners to control the sway when the excavator lifts the unit.
5. The two people on the turbine are to dismount from the turbine.
6. Lift slowly using the excavator and check if the unit is balanced.
7. Two people are assigned to control the unit using the ropes during the lifting operation. One person is assigned to each rope.
8. The unit is lifted and moved on shore.
9. [Optional] - Transport the unit to a storage location.
10. When the unit is being place on shore, the furthest guide rope has to provide slack to the rope.
11. One person must board the unit and must open the shackles to retrieve the slings.

Responsibility, completion and review:
Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak March 2017

Marine Renewable Procedure – Manned turbine deployment

Purpose: To perform a manned turbine deployment using Zodiac boats the following safety procedures and regulations must be followed.

People: For a lightweight turbine: 1 Zodiac driver, 2^{+} crewmembers (3 people minimum)
For a heavyweight turbine: 2 Zodiac drivers, 4^{+} crewmembers (6 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Steel toe boots, hard hats and safety vests
- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- Zodiac operators must comply with *Marine Renewable Procedure – Safe boating.*
- Ensure the turbine is functional and buoyant before performing the deployment.
- No turbine is to be deployed without a steel cable safety line.
- Prior to attaching Zodiacs to the turbine check the turbine for any sharp edges that may puncture the Zodiac pontoons.

Education and training prerequisites:

- Knowledge on how to tie Zodiac boats to the turbines

Equipment and tools required:

- Mooring line, shackle, retrieval pole
- Steel cable

Steps to complete task safely:

1. Launch the turbine according to either *Marine Renewable Procedure – Excavator Deployment* or *Marine Renewable Procedure – Launching and retrieving trailered turbines*.
2. Use a ½ inch or large Amsteel blue rope of sufficient length as the main mooring line. Shackle the main mooring line to a buoy connected to an anchor.
3. Attach a buoy to the other end of the mooring line for easy access later.
4. Ensure that each Zodiac contains a two person crew, one driver and one crewmember ready to tie the Zodiac to the turbine.
5. Have the Zodiac get close the turbine's pontoon and attach the Zodiac from two points to the pontoon. The rear rope should take the bulk of the load and the front rope should be used to secure the Zodiac nose to the turbine's pontoon.
6. For heavy turbines, repeat steps 4 and 5 with a secondary Zodiac.
7. For the remainder of the procedure each Zodiac must now contain a three person crew. Have one additional person board each Zodiac.

8. Ensure that the turbine is out of the water. The turbine blades may be tied together to ensure that they do not spin during transportation. Drive the turbine to the mooring location.
9. Approach the buoy at the end of the mooring line, retrieve it and bring it onto a Zodiac.
10. Remove the buoy and attach the two ends of the turbine bridle to the main mooring line using shackles.
11. If the turbine bridal and pontoons are not rigidly connected, two people should board the turbine and pick up the bridle assembly from both end and lift it. The Zodiac driver should backup the Zodiac unit slowly allowing tension to build in the connection between the bridal and pontoons. When bridal is under tension, the two people onboard should drop the bridal assembly into the flow ensuring sufficient clearance such that the assembly does not hit the turbine.
12. The driver of the Zodiac(s) must put the engine on idol and let the turbine stabilize in the flow.
13. Once the turbine has stabilized in the flow, each Zodiac can be untied from the turbine pontoon.
14. Attach a steel cable safety line from the turbine to the shore. The steel cable may be attached to a large secure shore structure such as a tree or a pre-drilled shore anchor.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Manned turbine retrieval

Purpose: To perform a manned turbine deployment using Zodiac boats the following safety procedures and regulations must be followed.

People: For a lightweight turbine: 1 Zodiac driver, 2^{+} crewmembers (3 people minimum)
For a heavyweight turbine: 2 Zodiac drivers, 4^{+} crewmembers (6 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Steel toe boots, hard hats and safety vests
- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- Zodiac operators must comply with *Marine Renewable Procedure – Safe boating.*

Education and training prerequisites:

- Knowledge on how to tie Zodiac boats to the turbines

Equipment and tools required:

- Rope, hammer, crescent wrench

Steps to complete task safely:

1. Drive a Zodiac with a three person crew to the turbine's location.
2. One person boards the turbine and detaches the steel safety line and puts it into the Zodiac.
3. The Zodiac with the spool of wire rope drives towards the shore and while driving the slack on the wire rope is brought into the Zodiac.
4. When the Zodiac gets to the shore disconnect the steel safety line from the shore. Either return to the line to shore or coil the line on the shoreline for retrieval later. Leaving the line in the Zodiac creates an unnecessary tripping hazard.
5. Have the Zodiac get close the turbine's pontoon and attach the Zodiac from two points to the pontoon. The rear rope should take the bulk of the load and the front rope should be used to secure the Zodiac nose to the turbine's pontoon.
6. Repeat steps 1-3 with a second Zodiac for heavyweight turbines.
7. Have two people board the turbine unit and bring the turbine out of the water. The Zodiac(s) should drive forward to remove any tension on the mooring line.
8. Check the turbine unit for any components hanging underwater via chains or rope and if possible remove the components from the water and place them onto the turbine pontoon platform.
9. Drive the Zodiac further upstream until the main mooring line becomes accessible.

10. Detach the two-leg bridle from the main mooring line and put a small buoy at the end of the mooring line and drop it into the water.
11. The two people on the turbine should return to the Zodiac and drive back to the launch site.
12. Remove the turbine from the water according to either *Marine Renewable Procedure – Excavator Deployment* or *Marine Renewable Procedure – Launching and retrieving trailered turbines*.
13. [Optional] - Retrieve the mooring line by disconnecting the mooring line from the buoy connected to the anchor line and lifting the line into a Zodiac.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Manless turbine deployment

Purpose: To perform a manless turbine deployment from shore at the CHTTC site the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 3+ crewmembers (4 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Zodiac operators must comply with *Marine Renewable Procedure – Safe boating.*
- Ensure the turbine is functional and buoyant before performing the deployment.
- No turbine is to be deployed without a steel cable safety line.

Education and training prerequisites

- Knowledge on how to tie a Prusik knot.

Equipment and tools required:

- Mooring line, rope, retrieval pole, shackle
- Steel cable

Steps to complete task safely:

1. Launch the turbine according to either *Marine Renewable Procedure – Excavator Deployment* or *Marine Renewable Procedure – Launching and retrieving trailered turbines*.
2. Use a ½ inch or large Amsteel blue rope of sufficient length as the main mooring line. Shackle the main mooring line to a buoy connected to an anchor.
3. Attach a buoy to the other end of the mooring line for easy access later.
4. Attach a long rope to the end of the truck and pass it through a pulley secured on the shore.
5. A Zodiac crew of at least two people are to retrieve the end of the mooring line with the buoy and bring it to shore. If the mooring line is 1 inch or larger, then use the smaller rope to bring the end to the shore, pass it through a pulley secured on the shore and attach it to the tail of the truck and use the truck to bring the end of the mooring line to the shore.
6. Ensure that the truck is in low gear on four-wheel drive.
7. Attach the end of the mooring line to the bridle on the turbine using a shackle. If the tension on the mooring line is too much, use a Prusik knot with a smaller rope on the mooring line 5 to 10 meters (15 to 30 feet) from the end and attach it to a secured come-along and remove tension from the end of the mooring line.
8. One person by the pulley and one person in the truck with 2 radios should conduct the deployment. The person standing by the pulley should communicate the speed and direction with a person driving the truck.

9. A minimum of two people on the zodiac should monitor the deployment closely and communicate with the person in the truck on the behavior of the turbine.
10. When the turbine is finally at its place, the tension on the deployment line has to be released.
11. One person from the Zodiac jumps on the unit and detaches the deployment line.
12. Attach a wire rope safety line from the shore to the turbine. The wire rope may be attached to a large secure shore structure such as a tree or a pre-drilled shore anchor.
13. The truck driver drives forward and removes the deployment line from the water entirely.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Manless turbine retrieval

Purpose: To perform a manless turbine retrieval from the shore the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 3+ crewmembers (4 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies, hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (optional)

Additional safety regulations:

- Zodiac operators must comply with *Marine Renewable Procedure – Safe boating.*

Education and training prerequisites

- Knowledge on how to tie knots

Equipment and tools required:

- Amsteel blue, rope, retrieval pole
- Shackles

Steps to complete task safely:

1. Drive a Zodiac with a three person crew to the turbine's location.
2. One person boards the turbine and detaches the wire rope safety line and puts it into the Zodiac.
3. The Zodiac with the spool of wire rope drives towards the shore and while driving the slack on the wire rope is brought into the Zodiac.
4. When the Zodiac gets to the shore disconnect the steel safety line from the shore. Either return to the line to shore or coil the line on the shoreline for retrieval later. Leaving the line in the Zodiac creates an unnecessary tripping hazard.
5. A sufficient long ½ inch Amsteel blue rope is used to bring to the turbine to the shore. One end of the rope is attached to the truck and the spool of Amsteel blue is loaded onto a Zodiac. The Zodiac drives towards the turbine and the other end of the line is attached to the bridle of the turbine.
6. When the other end is attached securely to the turbine, the truck slowly drives forward and brings the turbine towards the shore.
7. When the turbine arrives to shore, the main mooring line has to be detached from the turbine. Either retrieve the mooring line from the water or attach a small buoy to end of the mooring line and released it into the water.
8. Remove the turbine from the water according to either *Marine Renewable Procedure – Excavator Deployment* or *Marine Renewable Procedure – Launching and retrieving trailered turbines*.

Responsibility, completion and review:
Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Flow measurements in front of a surface mounted kinetic turbine

Purpose: To perform flow measurements using an ADV or ADCP around a surface mounted hydrokinetic turbine from the turbine's pontoon platform, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 2^{+} crewmembers (3 people minimum)

Hazards:
Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (ticks, mosquitos, horse-flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:
- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:
- Watercraft operator must comply with *Marine Renewable Procedure – Safe boating.*
- The turbine must be stopped during the procedure except when performing the measurements.
- No personnel are to operate a vessel directly upstream of a deployed turbine when it is operational.
- A safety boat is required at all times to be either on the side of the turbine pontoon or behind it when anyone is working on the turbine's pontoon platform.
- All personnel are to work at the rear of the turbine unless they are required to be upfront of the turbine.

Education and training prerequisites:
- Knowledge on how to create the custom mounting bracket for the blue pontoon measurement arm.

Equipment and tools required:
- Laptop (Toughbook recommended)
- Blue pontoon measurement arm, custom mounting brackets and clamps
- Measurement instrumentation and all associated cables and hardware

---

Steps to complete task safely:
1. Connect the blue pontoon measurement arm to a custom mounting bracket. An ADV can be secured to the green ADV clamps and an ADCP can be secured to the ADCP bracket. Two clamps are used for securing the mount to the turbine.
2. Two people carry the mount and instrumentation to the front of the turbine and secure it to the front of the turbine.
3. Ensure that the assembly is secured at a location containing a string support beam.
4. Connect all data and power cables to the measurement instrumentation. The cable is tied using tie wraps all the way to the back of the turbine.
5. Connect the cables to a computer (preferably a Toughbook).
6. Perform flow measurements. All measurements are to be taken with the personnel at the rear of the turbine.

Responsibility, completion and review:
Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Load measurements around a surface mounted kinetic turbine

Purpose: To perform load measurements around a surface mounted hydrokinetic turbine from the turbine's pontoon platform, the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 2^{+} crewmembers (3 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, crushing, bruising, slipping, falling, drowning, noise, impacts and collisions

Biological: Wildlife (bears, snapping turtles), insects (ticks, mosquitos, horse-flies hornets) and flora (poison ivy, poison oak, poisonous sumac)

Chemical: Fuel fumes, exhaust and gasoline

Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

---

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves (recommended)

Additional safety regulations:

- Watercraft operator must comply with *Marine Renewable Procedure – Safe boating.*
- The turbine must be stopped during the procedure except when performing the measurements.
- No personnel are to operate a vessel directly upstream of a deployed turbine when it is operational.
- A safety boat is required at all times to be either on the side of the turbine pontoon or behind it when anyone is working on the turbine's pontoon platform.
- All personnel are to work at the rear of the turbine unless they are required to be upfront of the turbine.

Education and training prerequisites:

- Knowledge on how to operate the universal mount.

Equipment and tools required:

- Load cell, chain link, hand winch, shackles
- Assorted tools

Steps to complete task safely:

1. Ensure radio communication with the person on shore with the load cell is functional.
2. The load is transferred to a chain link during the installation of the load.
3. A hand winch with a short chain and hooks at the end is used to pull on the mooring. Ensure that the chain and hooks have the same rating as the main mooring line.
4. A suitable load cell is installed and the load is transferred into it. Loads are applied with the load banks of the grid.
5. The transfer chain is disconnected.
6. Perform the desired load cell measurements.
7. The transfer chain in reconnected.
8. The load cell is removed and the load transferred to chain.

9. A hand winch with a short chain and hooks at the end is used to pull on the mooring. Ensure that the chain and hooks have the same rating as the main mooring line.
10. The load is transferred back to the main mooring line.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations/guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017

Marine Renewable Procedure – Retrieving and replacing buoys

Purpose: To safely retrieve and replace buoys attached to the anchors, mooring lines or submerged structures in high energy flows the following safety procedures and regulations must be followed.

People: 1 watercraft operator, 3^{+} crewmembers (4 people minimum)

Hazards:

Physical: Pinch points, sprains, strains, cuts, scrapes, rope abrasion, slipping, falling, drowning, noise, impacts and collisions
Biological: Insects (mosquitos, horse flies, hornets)
Chemical: Fuel fumes, exhaust and gasoline
Environmental: Sun, wind, rain, snow, ice, extreme temperature, waves, rapids and shallow areas

Personal protective equipment or safety equipment:

- Personal flotation device
- All safety equipment listed in Section 6.3 of *The Canadian Hydrokinetic Turbine Test Centre Safety Rules and Regulations*
- Work gloves

Additional safety regulations:

- Watercraft operators must comply with *Marine Renewable Procedure – Safe boating.*
- For replacements performed using the blue pontoon, plywood sheets are to be positioned on the blue pontoon grating in areas that require kneeling, sitting or lying.
- Crewmembers are to be careful not to allow lines to become tripping hazards or get tangled in any watercraft propellers.
- Knowledge on how to tie a Prusik knot.

Equipment and tools required:

- Retrieving pole
- Buoys and appropriately sized shackles [For replacements only]
- Tool bag containing needle-nose pliers, crescent wrench and hammer [For replacements only]

Steps to complete task safely:

Retrieving a buoy

1. Have the watercraft driver nose up to the buoy that is to be replaced and stay steady in the flow.
2. Use the retrieving pole to grab the buoy from underneath, at the loop.
3. Lift the buoy on board the watercraft. If there is too much force acting on the retrieving pole to lift the line by hand, abort the activity and return using the blue pontoon.
4. If using the blue pontoon on a heavy line, tie a Prusik knot to the line and hook a winch cable to the knot. Use the electric winch at the back of the Zodiac to bring the line in.

Replacement using Zodiac boat

1. Collect and inflate replacement buoys as necessary. Ensure that the new buoys were not damaged during storage or shipping.
2. Obtain appropriate sized shackles for the replacement buoys.
3. Have the Zodiac driver nose up to the buoy that is to be replaced and stay steady in the flow.
4. Use the retrieving pole to grab the buoy from underneath, at the loop.
5. Lift the buoy on board the boat. If there is too much force acting on the retrieving pole to lift the line by hand, abort the activity and retry using the blue pontoon replacement method.

6. Secure the buoy by wrapping the line around a sturdy point on the Zodiac (e.g. the measurement arm).
7. Once the line is secured, remove the shackle from the existing buoy and remove the buoy from its line.
8. Using a new shackle attach the replacement buoy to the line. Ensure that the replacement buoy is secure and the cotter pin is in place.
9. Release the line and throw the new buoy off the front of the boat.

Replacement using blue pontoon

7. Collect and inflate replacement buoys as necessary. Ensure that the new buoys were not damaged during storage or shipping.
8. Obtain appropriate sized shackles for the replacement buoys.
9. Have the blue pontoon driver nose up to the buoy that is to be replaced and stay steady in the flow.
10. Be careful not to damage the replacement buoys on the grating of the blue pontoon.
11. Use the retrieving pole to grab the buoy from underneath, at the loop.
12. Lift the buoy on board the blue pontoon. If there is too much force acting on the retrieving pole to lift the line by hand, tie a Prusik knot to the line and hook a winch cable to the knot. Use the electric winch at the back of the blue pontoon to bring the line in.
13. For long lines, use both the back and central winches in conjunction with several Prusik knots to retrieve the line.
14. Secure the buoy by wrapping the line around sturdy point on the blue pontoon (e.g. the measurement arm).
15. Once the line is secured, remove the shackle from the existing buoy and remove the buoy from its line.
16. Using a new shackle attach the replacement buoy to the line. Ensure that the replacement buoy is secure and the cotter pin is in place.
17. Release the line and throw the new buoy off the front of the blue pontoon.

Responsibility, completion and review:

Workers are to ensure that all duties are performed in accordance to training, established health and safety regulations, guidelines, policies and procedures. Notify a supervisor of any injuries, illness, safety or health concerns which are likely to harm anyone on the premises. This task may be monitored periodically to ensure compliance and effectiveness.

Last Revised by: Jody Soviak – March 2017