

State of Georgia Marshland Protection Permit

Description of Proposed Activity

We would like to modify an existing permit (#673) (SAS 2012-00542, NWP #5) of an eddy covariance flux tower in a *Spartina alterniflora* dominated marsh at the head of a small creek off the Duplin River to study exchange of heat, water and carbon between the marsh and the atmosphere. This instrumentation is part of a National Science Foundation grant awarded to the University of Georgia to study long-term ecological processes in *Spartina* marshes on the Georgia coast (see Georgia Coastal Ecosystems Long Term Ecological Research project <http://gce-lter.marsci.uga.edu/>). Data collected from this instrumentation and research results obtained also benefit the Sapelo Island National Estuarine Research Reserve (SINERR) in understanding climate change, sea level rise and marshland response.

The eddy covariance flux tower is an advanced weather station that not only measures standard meteorological parameters but also carbon and water concentrations at fast sampling rates. Instrumentation on the tower includes a sonic anemometer and a closed-path infrared gas analyzer to measure the three-dimensional wind vector, air temperature, and concentrations of CO₂ and H₂O. Other instrumentation includes soil sensors (soil heat plates, an averaging thermocouple, a soil water content reflectometer, and a pressure transducer for water level), atmospheric sensors (humidity, temperature, pressure, rainfall), up and down looking radiation sensors (short wave, long wave and photosynthetically active radiation) and a digital camera to document the growth cycle of *Spartina alterniflora*. The tower is powered by solar panels placed within 30 feet of the tower that recharge a bank of batteries housed on the flux tower platform.

Communications and data transmission between the tower and a base station by license-free 900 MHz spread-spectrum radios with Yagi antennas. Radio transmission power is limited in the modems to comply with Federal Communications Commission (FCC) regulations (<1W). The maximum range for transmission (line-of-site) is about 20 miles, but <0.5 mile if there are obstructions like trees. In transmission tests, we received strong signals from the interior marshes up the Duplin River to Marsh Landing (≤5 miles). These tests have also shown that radio transmission to the UGA Marine Institute is not possible as the upland forest blocks the signals. Thus a base station will be set up at Marsh Landing where a data and communications server has been installed. A weatherized computer and cellular modem at Marsh Landing are then used to send the data to UGA for processing and analysis.

The area chosen for the installation of this flux tower is in marshland that is between the Duplin River and upland forest of Sapelo Island (see Fig 1). This site was chosen for a number of reasons: 1) it has a direct line of site to Marsh Landing where a radio receiving station for communications and data transmission has been installed; 2) it has a large area of marsh that will be sampled that is far enough away from the effects of upland trees or hammocks; 3) there is a small creek that will also be used to study the transport of carbon from the marsh to the Duplin River (see Fig 2); and 4) the site is within the SINERR, enhancing the value of ecological studies that are already underway.

The flux tower itself is about 20 feet tall erected on a platform 5'x5' square. It is powered by 6 solar panels and accessed via a boardwalk for servicing and maintenance (approximately once a month). The boardwalk will be approximately 115m in length (25m already existing) and will run from the solar panel location to a point in the marsh 85m from the flux tower (Fig 2). The boardwalk will be accessible by walking ~175m across the marsh. We do not want unauthorized people having access to the flux tower. The requirement of boating to the Duplin creek edge and walking across the marsh will act as a deterrent for access. The total square footage over vegetated marsh for this project is approximately: 26(tower platform)+24(solar panels)+440(boardwalk)=490 sqft. **This will cut the total impacted area almost in**

half from what was previously permitted.

We do not want to impact the growth of the *Spartina* marsh. This area is dominated by medium and short *Spartina alterniflora* that will grow to heights of approximately 0.5-1 m and 0.05-0.5 m, respectively. In order to minimize our impact, the decking material that will be used is ThruFlow decking system (<http://www.thruflow.com/>) so that light can penetrate to the marsh surface. For a deck raised 3 feet from the marsh surface, 70% of the light availability will penetrate to the surface below, thus allowing *Spartina alterniflora* to grow beneath the tower platform and boardwalk. The existing decking is raised 3 feet (0.9 m) above the marsh surface. The new decking that will be installed will be raised 1 foot from the marsh surface to still allow water movement under the decking but allow access from the marsh surface.

All lumber used in the construction of the tower platform and boardwalk will be fiber-reinforced polymer lumber (Polyforce lumber by Tangent). We will not use pressure treated lumber, as we do not want any chemicals leaching into the marsh that will impact *Spartina alterniflora* growth.

Figure 3 is a series of drawings that shows the scale of the flux tower installation and all of its components:

Fig 3a is a plan view showing the flux tower platform (5'x5'square, 25 sqft) together with the boardwalk (115 m ~ 377 ft) that will be used for access and servicing the tower. The tower is mounted on a steel plate on the platform to provide strength at the base. The tower is designed so that it can be released from one of its mounting points at its base and can pivot on the remaining two brackets in order to raise and lower the tower from the boardwalk. The tower can be lowered to rest on two sawhorse legs for servicing. Solar panels are placed near the boardwalk for cleaning (if necessary).

Fig 3b is a side view of the proposed installation with a 30ft tower showing the two heights of the CO₂/H₂O/heat flux measurements and the height for radiation measurements from the marsh (other sensors not drawn in). Three guy wires (only two are drawn in) will secure the tower from any vibrations from wind. This tower is designed so that it can handle 12 square feet of wind loading for 80 mph winds. The prevailing winds in this area are typically 25 mph.

Fig 3c is a close up view of the platform design showing the tower base plate and mounting bracket. Also housed on the platform base is a battery box and gas cylinder box. The battery box houses six 12V, 100 Ah marine grade batteries that are continuously recharged by the solar panels. The gas cylinder housing will contain two small gas cylinders that are used to calibrate the CO₂ sensor every 2-3 months.

Fig 3d is a side view of the flux tower platform showing 16ft fiberglass pilings that have been driven into the marsh mud. The elevation of the tower platform will be 4 feet from the marsh surface

Fig 3e shows the mounting structure for the six 80 Watt solar panels. Two horizontal rows of three solar panels is best so that the air flow between the panels will limit any stresses and drag on the structures. Total square footage for solar panels is 24 sqft.

Fig 3f are schematics for the boardwalk. The boardwalk will stand 3 feet from the marsh surface with posts driven into the marsh every 5 feet. The width will be 14 inches so that the total square footage of boardwalk will be 440 sqft.

Fig 3g is an existing site photo showing all of the installed components of the flux tower.

A photo of an installed flux tower in Plum Island Sound, Massachusetts is shown in Fig 4. This installation is part of the Plum Island Ecosystems LTER (<http://ecosystems.mbl.edu/pie/>) project and serves as a cross-site comparison with this installation in the Georgia Coastal Ecosystems LTER.

This additional information is provided for compliance with Coastal Marshlands Protection Act of 1970 information requirements:

OCGA 12-5-286. Permit to install scientific equipment.

(b) Each application for such permit shall be properly executed and filed with the department on forms as prescribed by the department, and shall include:

(1) The name and address of the applicant-

Fred Hay
Sapelo Island Manager
Georgia Department of Natural Resources
(912) 485 2251 ext. 103, email: fred_hay@dnr.ga.gov

(2) A plan or drawing showing the applicant's proposal and the manner or method by which such proposal shall be accomplished. Such plan shall identify the coastal marshlands affected-

Please refer to attached document and drawings.

(3) A plat of the area in which the proposed work will take place-

See attached document and drawings.

(4) A copy of the deed or other instrument under which the applicant claims title to the property or, if the applicant is not the owner, then a copy of the deed or other instrument under which the owner claims title together with written permission from the owner to carry out the project on his land. In lieu of a deed or other instrument referred to in this paragraph, the committee may accept some other reasonable evidence of ownership of the property in question or other lawful authority to make use of the property; The committee will not adjudicate title disputes concerning the property which is the subject of the application; provided, however, the committee may decline to process an application when submitted documents show conflicting deeds-

See attached

(5) A list of all adjoining landowners together with such owners' addresses, provided that if the names or addresses of adjoining landowners cannot be determined, the applicant shall file in lieu thereof a sworn affidavit that a diligent search, including, without limitation, a search of the records for the county tax assessor's office, has been made but that the applicant was not able to ascertain the names or addresses, as the case may be, of adjoining landowners-

No adjacent landowners. Surrounding marshland is protected by GA DNR.

- (6) A letter from the local governing authority of the political subdivision in which the property is located, stating that the applicant's proposal is not in violation of any zoning law;***

A letter has been received from the McIntosh County Zoning Department stating that the proposed project is not prohibited under current zoning. The letter is not conditioned.

- (7) A non-refundable application fee to be set by the board in an amount necessary to defray the administrative cost of issuing such permit. Renewal fees shall be equal to application fees, which shall not exceed \$1,000.00 for any one proposal and shall be paid to the department.***

Waived as GA DNR is the applicant.

- (8) A description from the applicant of alternative sites and why they are not feasible and a discussion of why the permit should be granted. Describe water dependent nature of project-***

This project has been previously permitted so most of the infrastructure is already in place. However, the purpose of this research is to evaluate the exchange of gases between salt marshes and the atmosphere, in order to understand the role that these wetlands play in the carbon cycle, to be able to model water flow in the Duplin River, and to be in a position to predict the effects of future changes such as sea level rise. There are a number of constraints imposed on the measurements that limit where the flux tower can be installed: 1) the flux tower has to have a direct line of site to Marsh Landing where a radio receiving station for communications and data transmission will be installed. A weather resistant computer and cellular modem at Marsh Landing then send the data to UGA for processing. Tests have shown that radio transmission to the UGA Marine Institute is not possible as the upland forest blocks the signals. The range limit for the radio communication along the Duplin is approximately 5 mi; 2) the flux tower has to have a large area of marsh that will be sampled that is far enough away from the effects of upland trees or hammocks. We do not want marsh photosynthesis and respiration to be masked by upland forest effects; 3) there has to be a well-defined water shed in order to study the transport of carbon from the marsh to the coastal waters; and 4) the site is best located within the SINERR since this research will expand on the ecological studies that are already underway. Also, the Duplin River acts as a well-defined watershed so that measurements occurring at the flux tower location can be scaled up to quantify marsh-atmosphere exchange over the whole system. An alternative site was considered on the western side of the upper Duplin River. However, this site does not have a well-defined watershed for studying carbon transport, as waters from New Teakettle Creek would complicate budgets of carbon exchange. This distance is also far for radio communications. Given these constraints there is no other alternative site for this eddy covariance flux tower.

This permit should be granted because this research will advance our understanding of how the Georgia marsh will respond to climate change and sea level rise. Our goal is to characterize the responses of the Spartina marsh to pulses and presses in salinity and inundation and thus this study should be of great interest to the Coastal Resources Division

of GA DNR and the NOAA NERR sites.

No alteration to the natural flooding and drying of the marsh will be made. In fact our purpose is to study the functioning of a natural marsh, and so every effort will be made to minimize our impact.

(9) A statement from the applicant that s/he has made inquiry to the appropriate authorities that the proposed project is not over a landfill or hazardous waste site and that the site is otherwise suitable for the proposed project-

Applicant has reviewed the Hazardous Site Index maintained by Georgia Environmental Protection Division. There are no landfills or hazardous waste sites at or near the proposed project location. A review of the Hazardous Site Index for McIntosh County, Georgia indicates that the subject property does not contain hazardous waste sites or landfills.

(10) A copy of the water quality certification issued by the department if required for the proposed project-

Water Quality Certification will be provided if required.

(11) Certification by the applicant of adherence to soil and erosion control responsibilities if required for the proposed project-

All activities will be conducted in accordance with all applicable, State, Federal and Local erosion and sediment control regulations.

(12) Such additional information as is required by the committee to properly evaluate the application-

This application has been prepared with consideration for the interests of the general public of the State of Georgia as defined in OCGA 12-5-286(g): OCGA 12-5-286. Permits to fill, drain, study, etc marshlands.

(g) In passing upon the application for permit, the committee shall consider the public interest, which, for purposes of this part shall be deemed to be the following considerations:

(1) Whether or not unreasonably harmful obstruction to or alteration of the natural flow of navigational water within the affected area will arise as a result of the proposal-

No harmful alteration to the natural flow of navigational water will occur during or as a result of this project. This project is approximately 200 m from Factory Creek, 250 m from the Duplin River (see attached map Figure 2). A platform will house all instrumentation and a boardwalk will be elevated to allow flow under the structure. This will minimize trampling of the marsh surface, which could lead to erosion.

Decking material that will be used is ThruFlow Decking System (<http://www.thruflow.com/>), which will allow light to penetrate to the marsh surface thus allowing *Spartina alterniflora* to grow beneath all decking. All lumber used in the construction of the tower platform, boardwalk, and solar panel mounts will be fiber-reinforced polymer lumber (Polyforce lumber by Tangent). We will not use pressure treated lumber, as we do not want any chemicals leaching into the marsh that will impact *Spartina alterniflora* growth.

(2) Whether or not unreasonably harmful or increased erosion shoaling of channels, or stagnant areas of water will be created -

No increased shoaling of channels or stagnant areas of water will result from this project. The project's goal is to have a minimum amount of impact to the marsh and adjacent creeks so that a naturally occurring environment exists for fluxes of CO₂/H₂O/heat between the marsh and the atmosphere.

(3) Whether or not the granting of a permit and the completion of the applicant's proposal will unreasonably interfere with the conservation of fish, shrimp, oysters, crabs, clams, or other marine life, or wildlife, or other resources, including but not limited to water and oxygen supply-

Time of year considerations will be given to the construction in order to minimize potential impacts to wildlife using the marsh surface such as crabs and birds. The project will have no impact on adjacent water quality, as erosion into tidal waters will be minimized because of the planned boardwalk that will be used for access.

All activities (building of boardwalk, flux tower platform, and the installation of the flux tower and solar panels) will be performed in a manner to minimize turbidity in the adjacent streams.

There will be no oils or other pollutants released into the marsh and subsequent streams as a result of this project.

All work performed during the installation of the flux tower will be done in a manner that will not interfere with any legitimate water use.

<u>Fred Hanf</u>	<u>2-21-21</u>
Signature of Applicant	Date