

A. IDENTIFICATION SHEET

Applicant identification

| | |
|-----------------------------------|--|
| Candidate (Last name, first name) | Shen, Eric |
| University/Department | McGill University/ Department of Mechanical Engineering |
| Study programme | Undergraduate |
| Email address | eric.shen@mail.mcgill.ca |
| Cycle du candidat | <input checked="" type="checkbox"/> Undergraduate <input type="checkbox"/> Post-doc <input type="checkbox"/> Master <input type="checkbox"/> Other. <i>Please specify</i> <input type="checkbox"/> Doctorate |

Supervisor identification

| | |
|----------------------------------|---|
| Supervisor (Surname, First name) | Sabih, Amar |
| University/Department | McGill University/ Department of Mechanical Engineering |
| Academic title or status | Senior Academic Associate Director |
| Email address | amar.sabih@mcgill.ca |

| | |
|--|--|
| Surname, first name of co-supervisor (if applicable) | Cliquez ou appuyez ici pour entrer du texte. |
| University/Department | Cliquez ou appuyez ici pour entrer du texte. |
| Academic title or status | Cliquez ou appuyez ici pour entrer du texte. |
| Email address | Cliquez ou appuyez ici pour entrer du texte. |

| | |
|--|--|
| Surname, first name of co-supervisor (if applicable) | Cliquez ou appuyez ici pour entrer du texte. |
| University/Department | Cliquez ou appuyez ici pour entrer du texte. |
| Academic title or status | Cliquez ou appuyez ici pour entrer du texte. |
| Email address | Cliquez ou appuyez ici pour entrer du texte. |

B. TITLE AND SUMMARY OF THE SCHOLARSHIP PROJECT

| | |
|---|--|
| Title of the scholarship project | A comprehensive field study to evaluate the sandbag flood fighting method and the applied measures in Quebec to treat the hundreds of tons of contaminated sand in 2019 flood crises. |
| Summary ¹ of the scholarship project (300 words) | <p>For many decades, the sandbag method was the only way to build temporary barriers or walls to fight the rising floodwater. However, this method is an expensive, inefficient, highly laborious technique and requires a very long time and resulting in hundreds of tons of contaminated sand.</p> <p>This project is part of ongoing research and design projects to develop innovative, sustainable, low-cost and labour flood barrier alternatives to the sandbags method in flood fighting.</p> <p>Our main goal is to implement the recent advancements in material science and structure design to develop new flood barriers concepts.</p> <p>The new flood barriers can help to achieve the following in comparison to the sandbag method:</p> <ul style="list-style-type: none"> • Low cost, sustainable, reusable, recyclable flood-barriers • Fast deployment flood-barriers • 95 % reduction in the workers and volunteers required to build flood-barriers • 95 % reduction in the time necessary to make flood-barriers • 95% reduction in flood fighting cost • Zero contaminated sand • No environmental and health risks <p>This research covered the part of the project dedicated to running a field study of the advantages and disadvantages of using the sandbag method.</p> <p>This study aims to document the sandbag experience before, during and after 2019 flood.</p> <p>The researcher will learn to document and study scientific data and follow the scientific steps to conduct a failure analysis procedure.</p> |

C. PROJECT DESCRIPTION

In which axis(es) does the project fit?

Axis 1 Axis 2 Axis 3 Axis 4 Axis 5

How does the project fit into the indicated axes? (200 words maximum)

The most common technique for preventing rising floodwaters from damaging properties is to set up a wall of sandbags. This traditional method proved that it is an expensive, inefficient, and laborious technique and requires a long time.

Using thousands of tons of sand every year in fighting floods in Quebec ends in an environmental crisis. All the used sand is considered a hazardous contaminated material that requires special treatment.

¹ The summary must explicitly include: 1) The objectives of the planned research, the methodology including the study region, the data used or populations involved, and the expected outcomes.

The collecting and treating process of thousands of tons of sand comes with a high cost over a long time. The gathered information from previous flood events in Quebec revealed that almost all the contaminated sand was dumped in landfills, and rivers without any treatment, causing severe health and environmental risks.

This project studied the treatment procedures and documented if any affected municipalities treated the contaminated sand.

Although the sandbags' dikes and walls are almost the only technique used in fighting 2017 and 2019 floods, many of these dikes malfunctioned because of the lack of knowledge of building these walls correctly. Therefore, this part of our ongoing research is dedicated to documenting the analyzing these malfunctions.

Axes 1, 2, 3, 4 and 5.

Which sector(s) is(are) involved in this project?

- Natural sciences and engineering
- Health
- Social sciences and humanities, arts and literature

How does the project involve the sectors indicated? (200 words maximum)

This project is mainly related to the health and technology sectors.

Health Sector: The collected information about the contaminated sand treatment highlighted that a high percentage of the used sand is not receiving the necessary treatment before dumping it in the landfills and rivers. The lack of proper treatment is expected to cause a severe health risk.

Technology: This project aims to understand the causes behind the failure of many sandbag dikes during 2017 and 2019 flood events. This project will help flood-fighting teams to know the consequences of using sandbags on the health and environment. Also, they need to adopt the new flood barriers techniques to avoid these problems.

What flood-related problem does this project address? (300 words maximum)

This project will focus on the following issues:

- 1- Disadvantages of depending on the sandbag method in flood fighting.
- 2- The severe problem of neglecting the required procedures to treat hundreds of tons of contaminated sand.
- 3- Sandbag dikes failure incidents during 2017 and 2019 floods in Quebec.
- 4- Failure to meet the essential flood management requirements when using the sandbag method before, during and after the flood event.

Project description/Methodology (600 words maximum)

For many decades, the sandbag method was the only way to build temporary barriers or walls to fight the rising floodwater. However, this method is an expensive, inefficient, highly laborious technique and requires a very long time and resulting in hundreds of tons of contaminated sand.

This project is part of ongoing research and design project to develop new innovative, sustainable, low-cost and labor flood barrier alternatives to the sandbags method in flood fighting.

Our main goal is to implement the recent advancements in material science and structure design to develop new flood barriers concepts.

This proposal covers the part of the project dedicated to running a field study of the advantages and disadvantages of using the sandbag method. This study will document the sandbag experience before, during and after 2019 flood.

The researcher will learn how to collect, document, analyze, and study scientific data and follow the steps to conduct a failure analysis procedure.

Benefits of the project for flood management for partners and in Quebec (300 words maximum)

Sandbagging has been the standard for fighting floods for many decades now. Despite being an old-fashioned, high cost and labour-intensive method, Quebec still chooses this practice as the primary prevention measure when fighting floodwaters. Unfortunately, the potential threat posed by the contaminants found in the sandbags used during floods has been disregarded on numerous occasions.

These contaminants can cause many illnesses, especially in the young and elderly. This comprehensive field study explained the different types of contaminants found in the contaminated sands, the impacts they bring on the public's health and safety, and potential treatment methods that can be used to neutralize the threat.

This study presented the treatment processes of the contaminated sand. These processes should be followed and applied to all contaminated sand collected after each flood season

Main results obtained (300 words maximum)

The sandbagging method has proven to be very costly in both the economic aspect as well as the required workforce and labour hours needed. Furthermore, the entire process concerning the decontamination of the sands used during the floods needs to be accounted for. These decontamination processes increase the overall cost of the flood response budget for cities. *In most cases, cities will completely disregard this step of post-flood procedures to save on the given budget. As stated by the city of Montreal representative, the city estimates that the sands do not threaten the public or the environment. The municipalities did not even look into analyzing sand samples for budget reasons.*

Based on the lack of data on the contaminants found in these contaminated sands, assumptions were made to include the general impurities that are almost guaranteed to be found in the sands.

A majority of these contaminants, when exposed for long periods or in too high concentrations, may lead to significant health problems, especially for the young and elderly.

To highlight the main topic of this paper, informing the public on the possible dangers of contaminated sands after a flood is a must. Furthermore, the flood-fighting teams in Quebec must understand that contaminated sands must be adequately treated before being used for other purposes such as yard work. If left untreated, many health threats are raised for the affected families, especially children and elders. Given all this information to reflect on, many people can now understand the inefficiencies of the sandbagging method and start opting for alternative flood combatting solutions that are much more efficient in the technical aspects while posing less threats of post-flood contaminations.

Knowledge mobilization activities undertaken as part of the award (e.g., participation in various events such as conferences, workshops; development of (or participation in) scientific papers, etc.).

The student was able to conduct a field study to collect data to help in understanding how Quebec deals with this problem. Moreover, the student analyzed the limited collected data and highlighted the lack of understanding of this problem.

The final report must be sent to the following email address by **March 15, 2022:**
poudrette.diane@uqam.ca .