

Floods, a danger to road safety

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Introduction

The Ministry for Ecological Transition website and the figures from both the *Consorcio de Compensación de Seguros* and the *Instituto Geológico y Minero de España* (Spanish Geological Survey) suggest that flood loss represents an estimated 800 million euros a year on average.

Due to their speed and unpredictability, flash floods are extremely hazardous to personal safety, specifically to road safety. Scenes of vehicles being carried along by powerful torrents of water have become the norm on our televisions every year. Every year, the chilling tally of human lives lost grows bigger too; people who were driving in their vehicles and were caught unawares by storms of this kind and were left helpless to do anything about it. Sometimes, perhaps, this was because they had no idea what they should have done. And what if you were surprised by a flood while in your vehicle, would you know what to do? Centro Zaragoza now presents a series of tips on what you should and should not do if you find yourself caught out by a flash flood when travelling in your vehicle.

If flooding or the carrying off of the vehicle seem imminent, it is almost certain that it is already too late to try to save it. Doing so would mean risking our lives.

As we will try to explain throughout this article, in a lot of the situations which we will go on to describe, when we find ourselves caught unawares by torrential rains or floods, we will unfortunately have to take it as a given that some sort of loss, be this major or minor, has already occurred, but we should avoid the way we behave meaning that the problem only gets worse and the loss grows bigger or even becomes irretrievable.

Before setting off



Picture 1. The unpredictability of flash floods makes them perilous enemies of road safety.

Source: Hermann Traub, Pixabay.

Information on the unforeseen circumstances which we might come across along the way is essential before we set out. Consulting the traffic news can lead to us opting to avoid passing through certain zones where torrential rains are expected to appear. It goes without saying that, given weather conditions that can make driving hazardous, the best bet is always to avoid trips that put our safety at risk.

It is nonetheless true that, at times, this kind of rainfall appears without prior warning, or with far greater force than the weather services had forecast. This means that the information that we can gather in relation to our journey is useful and often adequate, but, unfortunately, it is not always complete enough.

Another scenario that has to be considered before we go into how to get out of a vehicle if we are surprised by a

flood (even if it initially has nothing to do with driving) is when some owners attempt to save their parked vehicles when they see that a flood is about to engulf them or carry them away. If flooding or the carrying off of the vehicle seem imminent, it is almost certain that it is already too late to try to save it. Doing so would mean risking our lives. Obviously, it is not worth attempting this, as the chances of managing to do it are slim, whereas the risk of dying in the attempt is very high. As we will try to explain throughout this article, in a lot of the situations which we will go on to describe, when we find ourselves caught unawares by torrential rains or floods, we will unfortunately have to take it as a given that some sort of loss, be this major or minor, has already occurred, but we should avoid the way we behave meaning that the problem only gets worse and the loss grows bigger or even becomes irretrievable.

Avoid a hazardous situation

Inside a vehicle, the top priority is to reach safety by moving away from the place where the current passes through or zones that are susceptible to flooding, while seeking out high ground that offers safety.

Possibly the worst decision you can take in a flash flood is to drive the vehicle through water of an unknown depth. Vehicles start to slide around in only a few centimetres of water and you should always bear in mind that it is easy to misjudge the depth of water that has built up, especially at night, when the car's lights reflect off the surface of the water and you lose all reference to depth. What can look like a mere puddle might be several hand-spans deep, which proves enough to seep into the vehicle's engine and badly damage it or, what is even worse, if the water is travelling at speed, carry off the vehicle with its occupants still inside. Water that has accumulated also prevents you from seeing other items, such as rocks, tree branches, manhole covers or even other vehicles lying under trapped water. To summarise, the water surface may always look the same, but we won't be able to guess what lies beneath it.

We must therefore never attempt to pass through or over a flooded street or bridge because, if the depth is as little as 30 centimetres, certain vehicles can already begin to be carried off by the flow. We must always look out for an alternative route or stop our vehicle and stay safe before the situation worsens.



Picture 2. Looking for a high, safe place and trying not to use our vehicle is probably the best way we can help both ourselves and our family stay safe.

Source: StockSnap, Pixabay.



Picture 3. Don't try to save your vehicle if you see that it might be dragged away by flooding. It's already too late. If hard rains are forecast, get ahead of the situation and change where you park. Look for high ground that is safe for parking before it starts raining.

Source: David Mark, Pixabay.



Picture 4. The worst decision you can take in a flash flood is to drive the vehicle through water of an unknown depth.

Source: Julia Harwood, Pixabay.

Listening to radio stations which offer weather news in real time will be a great help in avoiding zones that can be subject to flooding. What is more, we might be able to hear advice on alternative routes that we can take to avoid risk areas.

Any solution other than moving to a safe place is ill-advised. So don't even think about pushing ahead to save a few minutes that can allow you to make it to that appointment you had on time or in the hope that you can get there earlier. Assume the loss that has already happened (as we said before), that you won't reach your destination at the expected time and that you won't be able to take refuge in your house straight away if that is where you were going to. No doubt this is a nuisance or a problem you weren't expecting, but it is not so serious; you still have time to avoid the consequences becoming worse. Stop your vehicle on high, safe ground and wait for the storm to pass. Never, under any circumstances, try to press on if doing so means taking the slightest risk of going through zones where there is stagnant water or a current running through at speed.

Why a vehicle starts to be dragged off

A dry street can turn into a torrent of water in a matter of minutes. The roadway will become flooded and we will have to act quickly and try to move out of the watercourse before the vehicle begins to become carried away. Depending on several parameters, such as the weight and shape of the vehicle itself, as well as the speed of the current or the depth of the torrent of water, sooner or later, it will cause the vehicle to be carried off. We shall now go on to explain how each of these parameters has a bearing on a vehicle starting to move off:

- Weight of the vehicle. Obviously, the more an object weighs (in this case, a vehicle), the harder it is for it to begin to move on account of external forces. The frictional force depends on both the coefficient of friction between the vehicle's tyres and the road surface and the weight of the vehicle and the slope of the road on which its tyres are resting. Thus, the more our vehicle weighs, the more unlikely it is that it will be carried off, or, rather, more thrust from the water will be required, i.e. a greater volume of water coursing at greater velocity, for the vehicle to begin to move off due to the flooding.
- Depth of the torrent of water. The vertical upward thrust which the vehicle will experience will cause it to tend to float, at least until it fills up with water and begins to submerge. The lower down towards the ground the vehicle's underbody is, the sooner it will begin to experience this vertical upward thrust.
- The velocity of the current and the surface area in contact. The mass of water that comes into contact with the vehicle will cause greater pushing the greater is the velocity at which it is moving and the greater the area of contact between the water and the vehicle. When the force prompted becomes greater than that which the tyres of the vehicle can withstand to avoid it moving off, the vehicle will begin to be dragged away.



Picture 5. Different factors, such as the weight and shape of the vehicle, as well as the depth and speed of the torrent of water, will cause it to start to be carried off.

Source: Joseph Thomas, Pixabay.

Flooded vehicle

If we have failed to react in time beforehand and abandon the vehicle or the danger zone, keeping calm will be essential. Easier said than done. We might become gripped by panic, which makes us take the wrong decisions that can prove fatal. Nerves and fear in an extreme situation only serve to make it worse than it already is. We have to act swiftly and calmly. Having reached this point, we can find ourselves faced with two situations: is our vehicle being borne by the current or is it becoming flooded in waters that we might describe as "calm"?

If our vehicle is being dragged along by the current, we should assess whether it is a good idea to get out of it, depending on the speed at which it is travelling. If the speed at which it is travelling is fast, Centro Zaragoza advises remaining in the vehicle until it slows down or comes to a halt as a result of the collisions it will be subjected to and getting out of the vehicle does not pose any greater danger than staying in it. In such circumstances, it is always advisable to have wound down the windows from the beginning, just in case you have to get out of the vehicle through them later on. It goes without saying that such a situation is bad enough in itself; very bad. We are in an extreme scenario where there is no going back, but the alternative of getting out of the vehicle when it is being carried along with some force is even worse, as it involves serious danger given that it is highly likely that we will suffer collisions, either on the part of our own vehicle or from other objects being dragged along at considerable speed.

If, at any particular time, our vehicle loses speed after hitting something, or even momentarily stops moving, we should try to open the door (it is highly unlikely that we will manage to do this if the car is still partly underwater) or escape through the windows (which is why it was important to have wound them down beforehand, while their electrics still worked) and quickly get to somewhere safe where we can climb up or get out of the water current.

If our vehicle is carried towards a flooded zone, the steps to take are the same as if we have an accident and fall into a pool of standing water. Epidemiological data taken in the United States suggests that in the range of 350 to 400 die every year in vehicles overcome by water, while vehicle flooding is the kind of accident involving a single vehicle in which death is most likely. [Austin R. Drowning deaths in motor vehicle traffic accidents. NHTSA, 2011].

Protocol for taking action in the event of vehicle flooding

If the situation has become harder to negotiate and we cannot get out of the vehicle in time, the only thing that can get us out of such tricky circumstances is to keep calm, be aware of what action to take, do it quickly and without hesitation, and rely on a hefty dose of luck. The aim of this article is not to tell readers how to keep calm or to seek a closer relationship with Lady Luck. Yet, what we can do over the course of these lines is give advice which, if followed properly and adequately, can help save our lives if our vehicle falls prey to flooding and we find ourselves inside it.

The way a vehicle moves on the water does not keep to any fixed pattern, although there are certain facets that tend to recur when a vehicle sinks. For example, a vehicle that falls into the water usually remains stable until it begins to fill up with water. When it does, it normally starts submerging in the zone where the motor is housed, this being the heaviest part. There comes a point when it proves impossible to open the doors because of the greater water pressure on the outside of the vehicle.

Another key characteristic is how long it takes a vehicle to become flooded. This time can be split into two distinct phases. The first phase is when the vehicle stays afloat. This can last between one and two minutes, that go from when the vehicle starts to become flooded until the moment when the water rises up to the windows. It is during this phase when we should open the window and get out. The second phase, when flooding becomes complete, lasts from the moment when the floating phase ends to when the vehicle ceases to be visible from the surface. In this second phase the water pressure prevents us from opening either the doors or the windows, which means that our chances of making it out alive are seriously reduced. Try to do everything possible to get out of the vehicle during the initial flooding phase. Don't waste time by hesitating or trying to ring the emergency services.

If we cannot open the door, Centro Zaragoza recommends following the SWCO protocol (Seatbelts, Windows, Children, Out) [McDonald GK, Giesbrecht GG. Vehicle submersion: a review of the problem, associated risks, and survival information. Aviat Space Environ. Med. 2013;84(5):498-510.]: unfasten your **S**eatbelt, wind down or smash the **W**indow, unharness the **C**hildren if any are present, and climb **O**ut of the vehicle to safety. Don't waste time calling the emergency services until you are somewhere safe and repeat to yourself "I need to undo my seatbelt, open a window, get the children out and get out of the vehicle." We have no way of knowing how long we have to do this. We might only have 30 to 60 seconds, so we should act diligently and escape before getting out of the vehicle becomes mission impossible.

We shall now go on to give a detailed explanation of how to carry out this protocol for taking action, which could save our lives in the event of an emergency.

Seatbelt

Inside the vehicle, the first step is to unfasten our seatbelt. If there are children and other passengers aboard who need our help, we shouldn't unharness them yet. Our top priority must be to open a means of escape as soon as possible. Furthermore, it is advisable to take off any jackets, footwear or clothing that we are wearing and which might hinder us from staying afloat when we get out of the vehicle.

Window

We wind down the window on the opposite side to the current, which we will very likely be able to do in the initial phases of flooding in our vehicle, even when it has electrically operated windows. It is vital that we act fast before the water reaches window level and floods the motorised window control system.

The problem can be exacerbated if the vehicle windows fail to open or only open slightly. When the electronic window operating system floods, the window motors stop working [Buning L R, Kessels J F, Merts M, Pauwelussen J P, Visser A G. Window operating mechanisms and door locking systems. Rijkswaterstaat Centre for Transport and Navigation, 2008]. If the water level still has not reached the windows and we have not managed to open them, we will have to try and break the glass as soon as possible. It would be helpful to carry a window-breaking hammer or system aboard at all times, as this will make smashing windows far easier and quicker if this is called for. The centre of the window is harder to break, so focus striking activity on the lower corners.



Picture 6. Testing being conducted by Centro Zaragoza. If our vehicle falls into the water, we should undo our seatbelt so we can open a means of escape as soon as possible.

Source: Centro Zaragoza.



Picture 7. Testing being conducted by Centro Zaragoza. Having a percussion hammer or a window-breaker will make this job far easier and swifter if required.

Source: Centro Zaragoza.

Centro Zaragoza has conducted various different tests to analyse the effectiveness of this sort of implement. Testing has revealed that it is indeed easier to smash windows by directing force at the corner of the window. It has also been seen that percussion rather than safety hammers enable smashing using less effort, besides the fact that they are less ostentatious and easier to carry inside the vehicle.

If you do not have a tool of this kind inside the vehicle, certain articles on these issues suggest that the “hack” of pulling off a head-rest and using one of the bars on it to smash the lower part of one of the windows can allow us to break through it. The testing performed by Centro Zaragoza does not inspire optimism, since the connecting rods of the head-rest were not designed to be put to this use and the most likely of events is that we will expend a lot of energy and lose hope without managing to break open the window.

Another of the tricks we can see in articles of this kind that are geared towards looking for a means of escape consists of ramming the vehicle’s wind-screen out of place by pushing with your feet. Once again, we are dealing with a technique that might have borne fruit in the past, when vehicles had wind-screens that were not stuck to the vehicle’s frame but instead joined to it using a rubber seal. So using your feet to try to push or ram out the wind-screen out with all of our strength will not be effective in this situation; save your strength for a better option.

Breaking windows is easier when the forces withstood by it are equal. This occurs in the first floating phase, when the water is yet to reach the windows and the vehicle is not completely flooded, when leaving the vehicle will prove far more difficult because we will have very little time left: only as long as we can hold our breath for. Whatever the case, however hard it might be, we have to break open the window. The water pressure will cause the glass to be forced inside the vehicle when it breaks, with all the risk this might entail for those aboard. This is a risk we will have to just take on the chin, because the alternative, that of waiting for the vehicle to be completely overrun by the water in a bid to try and open the door, is even worse.

It should be borne in mind that the wind-screen at the front is actually designed to make it more difficult to break than the other panes in the vehicle, for which reason, we shouldn’t try to escape through this one, which is also in the zone where water is more likely to start gushing into the vehicle because of its weight distribution. Instead of breaking open the forward wind-screen, we should try to concentrate our efforts on any of the vehicle’s windows. And remember: always focus on beating against the lower corner of the window.

Children and getting out

If children are travelling in the vehicle, or people who need special assistance, after we have opened up a means of escape we should immediately undo their seatbelts and get them out of the vehicle. It will be easier to get them out of the vehicle and follow them than to exit and try to rescue them from outside, so we must always remember that children should get out first. If there are several children travelling on board the vehicle, we should begin by helping the eldest among them, since it is more likely that they can manage to reach safety on their own, or even that they can be of use in managing to lead the other minors to safety. This is not the perfect solution, but it is probably the least bad in such a situation.



Picture 8. Children must escape from the vehicle first.
Source: Sean Dreilinger, Foter.com / CC BY-NC-SA.

If we have managed to open the windows or to break one open to establish a means of escape, we should exit the vehicle and try to make for high ground from where to notify the emergency services.

When all of the children are out of the vehicle, we can save ourselves without further delay. The vehicle might be full of water and start to sink at any time. When we are out of it, we should try to swim or aim for somewhere safe as soon as possible.

However dear to us some object is which is in the vehicle, or however important it might seem to us to save that laptop where we keep important work documents, under no circumstances should it occur to us to rescue our belongings. Everything other than life becomes of secondary importance in this situation.



Picture 9. After helping children or passengers who require help to get out of the vehicle, we must leave the vehicle without further delay before it sinks.

Source: Centro Zaragoza.

And what if we can't get out through the window?

If it is impossible to open or break a window, we will have to use a door to get out. It might seem terrifying, but we will have to stay inside the vehicle while the water flows in up to the point where the relative pressures become equal, which means waiting for the car to fill with water and the pressure from inside to become the same as outside. This won't happen when the space for occupants fills up with water, but when the boot has also flooded. The rear seats don't create a separate air compartment, but they do slow down the movement of the water towards the boot and, in so doing, also delay the moment when the pressures come to equal each other.

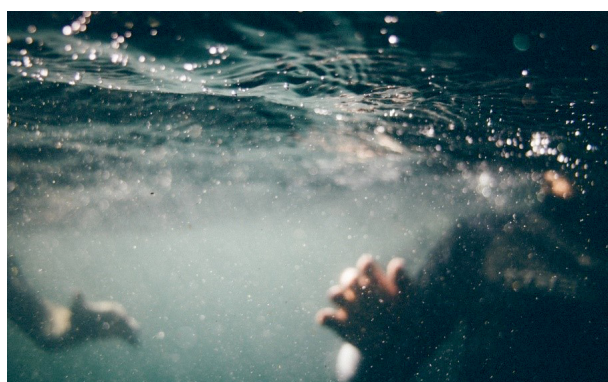
Whatever the case, we will have to manage to open the door by pushing hard while using its handle. This is the moment when we push ourselves to the limit before giving up. Our chances of surviving in such a case become drastically slimmer, which means that we should do all we can to smash the vehicle windows, but, if our windows are jammed and we don't manage to break them, it is not worth wasting energy trying to open the doors before the right time, because the water pressure will stop them from moving.

When we climb out of the vehicle, we could find ourselves disorientated. If the water covers us completely, we will have to try to swim and look out for a light source that enables us to know where the outside is, or see which direction bubbles take, which will show us the way to the surface.



Picture 10. If we don't manage to open the doors or to wind down or break the windows, we will have to wait until our vehicle fills up with water and the relative pressures become equal.

Source: Chris Gallagher, Unsplash.



Picture 11. Observing which way bubbles move will allow us to know where to go if we find ourselves disoriented.

Source: Free-Photos, Pixabay.

We will have to swim to a safe place from where to ring 112 if we have a phone that allows us to do this. If necessary, we will climb onto the roof to see where the place to head for is and swim towards it. We must never choose a place that forces us to swim against the current and, instead, the nearest dry ground, tree or house which we are trying to reach should permit us to swim with the flow.

If we don't know how to swim, we will have to try to reach the surface by propping ourselves on any object that we find along the way, such as the vehicle itself. We must try everything and never give up.

Once safe

Once out, we must not stay by the vehicle. We should reach high ground where we can be safe, while at all times being particularly careful of other cars that might start moving erratically due to the water dragging them and which could hit us. Neither is it at all advisable to stay on the roof of the flooded car after we have assessed the situation. If it starts moving due to the effect of the water, we will be carried along with it. We might also fall and injure ourselves if the car is hit and we are on top of it.

Even if we note that the water level is coming down, we must not go back to the car. The volume of water could rise in seconds without warning. Leave it to the emergency personnel to tow away your vehicle to a safe place.



Picture 12. After getting out of the vehicle, stay in a safe place and don't try to go back to it.

Source: Liga_Eglite, Foter.com / CC BY.

Escape plan

If we have the misfortune to find ourselves needing to escape from a vehicle that is being flooded, we will have a far greater chance of succeeding if we assimilate how we should act. It is therefore worth discussing with our family or anybody else with whom we regularly travel in our vehicle what the right steps to take are if we should find ourselves involved in an accident in which it is becoming swamped with water.

Try to recall the steps to follow in a situation of this kind from time to time as if this were a mantra:

- **S**eatbelts off.
- **W**indow down or broken.
- **C**hildren unharnessed.
- **O**ut (children first).

Our plan should, without doubt, include having the necessary tools available for following the steps described. As has been explained earlier, Centro Zaragoza always recommends having a tool in our vehicle to hand to help smash the windows.

It is probably also a good idea to practice unfastening the belt on child harnessing systems as rapidly as possible. This kind of training can be carried out every time we do this for children inside the vehicle, although, when we note that we have attained a good level from outside the vehicle, we must try doing it from inside, where it can prove a lot trickier.



Picture 13. Training how to get out of the vehicle whenever it is at a standstill can become a fun moment for all the family.

Source: Justgrimes, Foter.com / CC BY-SA.

And what if the vehicle has flipped over?

It could happen that our vehicle falls into a shallow irrigation ditch or a small brook and overturns. This will be an unsettling situation in which we are likely to feel disorientated; once again, keeping calm and acting swiftly will be key.

Firstly, before undoing our seatbelt, we will have to lean on the roof with one of our arms. This way, we will avoid hitting the roof with our head when we release ourselves and injuring our head itself or our neck. If we also rest our feet on the dashboard or the wind-screen and push against the seat right at the moment when we release the seatbelt, it will be easier for us to control how we move in those crucial moments.

Losing consciousness will cause us to lose our sense of the reality around us and even only a few inches of water could lead to us drowning. In fact, even if the windows are down, if our vehicle has overturned and is lying on a build-up of water, the liquid will find a way of seeping inside the part of the vehicle where the occupants are.

Should there be passengers in the rear seats that can escape, it would be preferable for them to be the first to undo their seatbelts, to the extent that they will be able to prop their feet on the front seats and, if there are people occupying these seats, this will offer greater stability to support them.

After releasing the seatbelt, we will have to turn ourselves over especially careful in order not to get stuck performing this manoeuvre. If any of our extremities becomes trapped while we are turning our body over, the situation can get even more problematic.

Once we have managed to get our feet closer to the centre of the earth than our head, we must assess the situation. What is the most advisable thing to do? In principle, if it is a small brook or puddle we are dealing with, then we are very likely to manage to open a door to try and get out. If there is a more substantial build-up of water, we might not be able to open the door due to the pressure differential previously discussed. We will have to decide whether it is a good idea to open the window of our vehicle (or even break it) to try to swim out underwater and then move on up to the surface. But be careful when you break the window, because shards may come back into the vehicle.

If the vehicle stays upturned and resting on its side, given that they are those least likely to cause themselves any harm when undoing their seatbelts and those who are not going to fall on top of the other people aboard, those inside who are closest to the ground can safely help to free those who are more exposed to falling because they are on the uppermost side of the vehicle.

Advice from Centro Zaragoza when we are inside a vehicle during a flood

It is obvious that advice mainly hinges on avoiding any risk situation, but, since this is not always going to be possible, Centro Zaragoza recommends assimilating the SWCO protocol, which is the one to follow if our vehicle falls into any build-up of water:

1. **S**eatbelts off.
2. **W**indow down or broken.
3. **C**hildren unharnessed.
4. **O**ut (children first).

And remember that, in this situation, your life and that of your family members is the only thing that is irreplaceable.