All sorts of people own 4x4’s of varying sorts. Most who own an expensive, shiny new vehicle want to get away from it all, but don’t know what to do or where to go to find out how to do the training. As with all these 4x4’s on the market these days the opportunity for overland travel has opened up considerably and more and more people are making the most of the opportunity to explore the far flung places such as Morocco, Africa and Australia. This is why I’m putting this off road driving manual together so that you can learn the basics of off roading and vehicle care.

The paragraphs and pictures will show you the basic procedures and the equipment that you may need or come across in you adventures with your 4x4.

The experience that I have gained has come from my many years with the military and my civilian expeditions. I have come across a myriad of different types of off road vehicles ranging from the basic four wheel drive vehicles to the latest military hardware, from manual transmissions to the more complicated automatic and triptronic transmissions and electric motors. Permanent 4x4 to part time 4x4, 6x6 and 4x6 drive vehicles, some that the civilian market will never see unless it’s on the news, etc.

The places that I’ve driven across range from Western and Eastern Europe, Far east, Middle east, Central America, Iceland and North to South Africa. Then there is all ways the UK, for good old home grown fun.
GETTING TO KNOW YOUR VEHICLE

The most important part of off road driving is forming a partnership with your vehicle. You both have your limits. While you can improve yours by practicing, your vehicle will usually not, yes you can modify it to aid your going when it gets tough but it will only do as it says on the tin.

1. WHAT IS A FOR WHEEL DRIVE?

The term four-wheel drive is applied somewhat unequally to a whole range of vehicles from quad bikes to trucks; some of these are not permanent 4x4 and have a selector to engage all four wheels for traction. A standard two wheel drive vehicle such as a car has its drive come from the engine through a gear box down the prop shaft or drive shaft to the front or rear wheels. A four wheel drive vehicle gets its drive from the engine through the gearbox then a transfer box to the prop shafts to the front and the rear wheels. The two types are shown in the pictures below. The majority of AWDs incorporate high and low gear ratios in the transfer box. The lower ratios are a real advantage for driving up hills or when slow speeds are required to cross rough ground. They also give very good pulling power which is why they are so popular with farmers and the like.

2. WHICH GEAR AND WHEN

Some of you will be driving automatics but some of us wouldn’t be without our manual boxes, so it appropriate to look at some of the general guidelines on which gear and when to use them.

2.1 General off roading

Select a gear that will allow you to progress at a modest speed but not too fast as to shake you or the vehicle to bits. Ideally you should be in four wheel drive when you think that you may have trouble
getting traction, but it’s recommended that you don’t have it in when you’re on tarmac unless it’s a permanent 4x4 vehicle such as a land rover.

2.2 **Tackling mud**
If you know what’s under the wheels then you can select low 2\textsuperscript{nd} or 3\textsuperscript{rd} this will allow the wheels sufficient torque to get you through the mud, you should never select a gear that causes the engine to labour as it may well stall and again you should never use to lower a gear as this will put too much power to the wheels and will cause you to spin and lose traction and then get stuck.

2.3 **Climbing hills**
Choose a gear usually low 2\textsuperscript{nd} or 3\textsuperscript{rd} that you think will get you to the top as you don’t want to be changing gear on the hill. To lower gear will see you end up with excessive torque and the vehicle will simply grind to a halt. To higher a gear on the other hand may cause the engine to labour and stall.

2.4 **Descending hills**
This procedure is explained later on but the general rule of thumb is low box 1\textsuperscript{st} gear, this will also incorporate the engine braking for you as well.

2.5 **Soft sand**
The rule here is to never use a gear that lets the wheels spin, each surface will be different so there is no hard and fast rule or gear to be in as long as you can keep momentum and not come to a grinding halt because you’re in the wrong gear you should not have to much a problem, again this procedure is explained later.

**NEVER RIDE THE CLUTCH**

2.6 **Automatics**
The only difference that you will find is that when you lock it into low 1\textsuperscript{st} to come down hills you may find that the engine doesn’t break, as efficiently as with a manual box. Also when using 2\textsuperscript{nd} or 3\textsuperscript{rd} to drive it has to go from 1\textsuperscript{st} first so you will have to pull away slower as to avoid wheel spin.
3. **GROUND CLEARANCE**

Perhaps the next part of getting to know your vehicle is looking underneath. Have a good look under it to see where the low parts are, such as diff’s, transfer boxes, exhaust pipe and wish bones.

Tyres, wheels and suspension will also have an effect on the clearance of your vehicle.

You can and should protect the underside of your vehicle if you are going to be doing a lot of off road driving over rocky or through wooded areas as the lowest parts will hit rocks and stumps and get damaged and then it could be expensive to repair.

Diff guards and transmission guards are the most common type of protection used. You can also get Dan bars to protect the steering rods or track rods, rock sliders to protect the sills, tree sliders to protect the sides of the vehicle when going through trees etc.

Suspension lifts will increase the height of the body of the vehicle, but not the level of the axels so therefore the diff’s will still need protecting. All that the suspension lift dose is to give you more wheel travel in the wheel arches so you can climb, and drop into or over obstacles such as ditches. It also raises the centre of gravity therefore reducing the angles that the vehicle can lean before it will roll over.
It is advised not to completely cover the underside of the vehicle with protection as the mud and sand etc will get trapped and then clog up any moving parts such as the prop shafts etc and will have to be removed when it comes to washing down after your trip off road.

You need to know where your diff’s are located on the axel such as in the centre or to one side or the other so when it comes to negotiating obstacles so you can pass over them without hitting them.

One more thing is the approach angle (from the centre of the front wheel to the bumper) ramp angle (the angle between the front and rear wheels to the centre of the lowest part of the underside) and the departure angle (from the rear wheels to the lowest point at the rear of the vehicle, such as tow bar etc)
**TYRES**

Tyre type is one of the most argued about add-ons in the 4x4 world as there are so many to choose from for so many different types of ground conditions.

4.1 **TREAD DEPTH**

For off roading the deeper the tread the better, that’s if you’re not going on sand or gravel then you need a less aggressive tread pattern. But for mud, clay, wet grass, snow or on hills you need deep tread.

4.2 **TYRE TYPES**

What types of tyres are best? As you can imagine that’s an imposable question to answer. No one tyre is going to do everything you might need it to do. Anything you might choose will be a compromise. Let’s look at the options. In very general terms, there are three types of tyre available.

4.3 **ROAD TYRES**

These as the name suggests, are designed for use almost exclusively on tarmac. Standard road tyres will last the longest and cost the least. They have little or no traction on mud or wet grass, although they may perform surprisingly well on sand, dry tracks and firm shingle, as long as they are big enough. However, they are by far the best and safest type of tyre for use on the road.

4.4 **50/50 TYRES or ALL TERRAIN**

These tyres are designed for 50% road and 50% off road use. They retain excellent road-handling capabilities, yet provide some surprisingly good performance for general off roading, but they will always let you down if the going gets really soggy.

4.5 **DEDICATED OFF ROAD TYRES**

These tyres perform great off road with excellent traction in all manner of conditions such as mud, gravel, snow and grass. There are some compromises in road handling and wet grip.

These tyres are usually directional forming a V shaped tread Patton. In mud they grip by forcing the V shape into the ground and pushing off of the tread in the desired direction. Another important part of these tyres is that they are self cleaning, as to say that they through the mud out via the wide grooves in them. So that even if they spin in deep mud the still grip as the mud is forced out as the turn and bite down into the ground. Yet these tyres won’t work in sand as they are too aggressive as the tread is too deep.

It may pay you to have more than one set of tyres for your 4x4 as we have disgust you will always have to compromise over your tyre choice, but this is changing all the time as tyre manufactures’ are coming up with different compounds and patterns that are reducing the amount of tyres we need to do the job.
4. **TYRE CHARACTERISTICS**

Having established some of the major groups, let’s look at what makes these tyres so different and some of the technical terms used to describe them.

![Tyre rubber-to-void ratios (Dunlop tyres)](image)

5.1 **TREAD SPACING**

This is measured by the lug-to-gap ratio. An ordinary car tyre, with very fine 'gaps' or slots, and wide ‘lugs’ or treads, has a ratio of about 6:1. This means the lugs are six times the width of the gaps. A tractor tyre has a ratio of 0.3:1 meaning the gaps are three times the width of the lugs. This allows the lugs to get a good grip, but more importantly, it allows the dirt to fall out of the tread so that the next time around the tread is clean of mud ready for a fresh bite into the ground.

5.2 **SIZE**

V-Based treads tend to be put on tall, narrow casings, which are the most efficient for soft, sticky terrain. A big (tall) tyre will roll more easily over a lump, while a skinny tyre requires less effort to push through mud—double the tyre width and you double the drag without doubling the grip. But for some surfaces a fat, wide tyre is best, so you can increase traction by temporarily reducing tyre pressure.

5.3 **PLY RATING OR LOAD INDEX**

A notional index of tyre strength is used to identify a given tyre’s maximum recommended load. It does not necessarily indicate the number of plies. Low ply ratings are better in soft conditions but are more susceptible to damage in rocky terrain.

5.4 **FOOT PRINT**

The ground contact area of a tyre is known as the footprint. A number of variables come into play here and this topic is discussed below in more detail.

5.5 **SELF CLEANING PROPERTIES**
This refers to the ability of a particular tread design to clean itself of mud, snow etc as it turns, so that the next revolution brings a clean section of tread into contact with the ground. In general, the larger the gap in the tread pattern, the more readily the tyre self cleans.

5.6 **DIRECTIONAL TREAD**
This is a tread formed with 'chevron’ grooves, providing good traction and self cleaning properties but only in one direction. When fitted, the chevrons must point forwards when you look at it from the top of the tyre.

5.7 **NON-DIRECTIONAL TREAD**
A general-purpose tread pattern designed so that the tyre can be run in either direction without loss of traction or self cleaning properties.

5.8 **OVERALL DIAMETER**
The diameter of an unloaded tyre mounted on its recommended rim and inflated to service pressure.

5.9 **SECTION WIDTH**
This is the width of the inflated tyre excluding any lettering or decoration.

5.10 **TYRE FOOTPRINTS**
The impression a tyre makes on the ground, known as its footprint, is one of the most important components of a tyre in off roading. It is also a complex issue. What shape of footprint do you want? In soft sand, snow and some types of mud a wide footprint works best because of the so-called floatation effect. In other circumstances where mud or snow covers a firm rocky base, a short narrow footprint allows the tyre to dig through to gain grip from the underlying rocks. Tyre pressures also play a large part. By reducing the pressures the width is increased and so is the length. It is the length that gives the grip off road. How far to let the pressures down by, if they are inner tube tyres then it’s ok to drop them by half the recommended TP, but you have to be more careful if they are tubeless, generally not below 15 PSI. It is important to re-inflate your tyres as soon as possible as driving on low tyres will heat them up and you stand the chance of cutting the side walls on rocks etc.
The Effect of tyre pressures on the length of the tyre footprint.

1. Over-inflated to 45psi. Reduces the footprint to 7.5 inches (−6.25%)
2. Normal inflation of 30psi. Footprint measures 8x8 inches.
3. Halving pressure to 15psi increases length of footprint to 11.5 inches (+43–75%)
4. Halving again to 7.5psi increases footprint to 15 inches (+87.5%)
ADDITIONS AND ACCESSORIES

Not all 4x4’s are the same, and they all perform differently. But whatever model you drive you can always add something extra onto it. Such as a tow hook, which is essential if you need to be towed or you need to tow.

ESSENTIAL EXTRAS

_Tow hooks_, these can be fitted to both the front and rear if not both. These should be securely bolted onto the bumper or chassis and be made of steel.

_Tow Ropes_; again a vital piece of equipment. These can be either the strap type or rope, but they need to be at least 7 meters long and a rated pull of 6000kgs min. The strop type can be used as tree protectors when winching.

_Jack_; whatever type of jack you use it needs to be adequate. You should carry a block of wood to spread the weight on soft ground.

_Tool kit_; you will need a tool kit, depending on the off roading you are going to do will depend on the amount of tools that you need. If you are off on an overland trip then a full tool box with it all the tools required to service and repair your vehicle if and when it’s needed. If it’s just weekend fun then the vehicle tool roll that comes with it plus the odd extra spanner, screwdrivers and mat be a hammer.

_Fire Extinguisher_; this is always a must and its law in mainland Europe to have in any vehicle. You really need a 2 litre dry powder extinguisher. The last thing you want is to run out of powder/water and your pride and joy goes up in smoke while you wait for the fire brigade.

_Spade or shovel_; this is yet another good piece of kit to have. It can be used not just to dig you out of the mud but also to dig that hole for the loo or you can always place it under the jack to stop it sinking in the soft stuff.

_A saw_; good for clearing your route of stray branches or just cutting wood for that overnight fire.

_First aid kit_; a definite must have, again its law in mainland Europe.

OPTIONAL EXTRAS

_Winch_; a winch is a very good extra to have if you have the money, and if you are going to be doing a lot of off road driving that involves severer terrain such as swamps, wooded hills or just travelling on your own.

_High lift jack_; these can really help you out of trouble such as raising the vehicle so you can get traction aids under the wheels, they can also be used as a jack or puller to aid recovery.

_Air Bag_; again this is a nice to have but it is really an expedition piece of kit. You can get two types the exhaust type, where the hot gasses from the exhaust fill the bag up via a tube attached to it. Then there is the air compressor type again the bag is filled via a hose but this is attached to the compressor, so that would be another bit of kit to carry.
Radio or mobile phone; no I don’t mean the one that gets radio, a CB radio so that you can broadcast as well as receive, so as to send an emergency message or keep in contact with others on the same trip. A mobile phone for the same reasons as a CB.
PREPARING YOUR VEHICLE

There is nothing quite like the lack of preparation to test your off road skills. Before you go off on your way there are a few basics that must be attended to first.

OIL
Check oil levels regularly, paying particular attention to the engine, gear box, transfer case, front and rear differentials and swivel housings. If necessary, consult your owner’s manual for full details of how to undertake these checks. You may have a warning light for the engine oil but the rest still need to be checked. If you cross a lot of water then pay particular attention to the colour of the oils as if they are a grey colour then they have got water in them and they need to be changed. It is important to have the right amount of oil in as when you are travelling up steep hills the engine could be staved of oil and stop.

WATER
Check the water /coolant level and top up as necessary. Always carry extra water with you just in case. If you have been playing in the mud then check the radiator for blockages.

BRAKES
Check fluid levels regularly. Drum brakes should be adjusted when necessary. Inspect the linings for wear and replace as necessary. Off-road use, with the associated mud, dirt and sand, can increase wear on pads and discs.

GREASE
Your vehicle is fitted with grease nipples on the prop-shaft and possibly on the steering arms. You need to top up the grease using a grease gun, but beware not to over fill as this will have the same effect as letting it remain dry, as you will split the seals and the grease will escape.

WHEELS AND TYRES
These are the first thing that comes in contact with the ground and therefore suffer the most damage, so inspect them carefully for rips, tears and pressures. The wheels also need looking at, look at the rims for dents etc that may affect the balance of the wheels. The wheel nuts also need to be checked and tightened so as not to come loose when we least expect it.

WINCHES
Check the condition of the rope, whether its wire or manmade fibre. Check the fair lead for damage, check the electrics and that it operates before you go out and that if it has a cut off that that works as well.

FILTERS
Check the air filter to see if it is clogged up with dust or if it is wet, if it is then it needs to be changed. Fuel filters need also to be inspected and replaced on a regular basis, oil filters need to be changed as part of your vehicles service.

**FANBELTS**
Check for wear and tear and that they are not slipping on the pulleys, if they are then change them as soon as poss

**WIPPER BLADES AND WASHERS**
Your blades should be soft with sharp edges, no nicks in them; washers should be free and have water in the washer bottle.

**LIGHTS**
Ensure your lights all work, that none of the lenses are cracked, as water will get in and blow the bulbs. Be aware that the wattage for head light bulbs in the UK is 55w, even though you can get 100w and above these are for spot lamps.

**NUMBER PLATES**
Ensure they are clean and not damaged as you may get pulled up by the police.

**ONE FINAL CHECK**
The big nut behind the steering wheel (that’s you) needs to be in first class working order. Off road there are no white lines to guide you, few signs, no traffic cops to stop you and, most important, often little room for error. You need your wits about you at all times, even more than when driving on the public roads. So stay away from the booze and avoid driving if you are not 100%.
**PREPARING YOURSELVES**

Making preparations for any trip off the black stuff doesn’t stop with the vehicle. You need to ensure that you and your passengers are equipped and prepared for what may or may not happen. Better safe than sorry; don’t risk anything by failing to take simple precautions.

When travelling alone you need to be totally prepared, and self sufficient, so give careful consideration to what you might need. What you need to take depends on where and for how long you are going for.

**CLOTHING**

It doesn’t matter where or when you go you should always take along some warm clothing. Someone in the party may get wet, cold or you could have to spend the night under the stars because you got stuck. Again wet weather clothing is also a must as it’s not always going to stay sunny all day even in the summer, if you get wet and cold and have no change of clothes by 4pm on a summers evening you could go down with hyperthermia, so always bring along some wet weather kit.

**FOOD AND DRINK**

Even for a short day out up the hills, take plenty of food and drink, just in case you have to stay out over night. This all needs to be kept in a sealed container to stop it from getting crushed or contaminated as it bounces around in the back of your vehicle.

**OTHER PROVISIONS**

Take a torch complete with spare bulbs and batteries, toilet paper in a waterproof bag, matches or a lighter, a pan, cups, fork, spoon and a sharp knife; sunglasses, sun block, insect repellent, umbrella, folding chair; maps and a ground sheet or poncho.

**OILS AND FLUIDS**

Take along spare oils, engine oil can be used in the transmission and vice versa but not automatics. Brake fluid and power steering fluid. Power steering fluid can be used as a substitute for oil in all but the engine if absolutely necessary.

**FUEL**

Always carry a spare can of fuel, and replace it as soon as you can after use or when you need it most it will be empty.

**MAPS AND GUIDES**

If it’s a new place that you are going to explore then get the relevant maps and guides and study them very carefully. The best types of maps to get are 1; 25,000 OS land ranger series. Find out where the start and end are and give your route to someone who will be at home just in case things
go wrong. Know how to read maps and know what the symbols mean so that you don’t end up driving on a footpath or private property without permission.

**PLAN WELL**

Before you go anywhere plan it, check the weather, the route to and from, nearest hospitals, have the right maps and permits and tell someone before you go, were you going when you leave and when you are due to return.
**DRIVING TECHNIQUES**

As it does with everything Hollywood lies about off-road driving. Charging around over humps and into rivers with massive splash waves all over the place, it’s just not like that in real life, unless you don’t care for you vehicle, the country side or yourself.

When you travel off road, particularly if you travel any distance you vehicle becomes your lifeline. So the last thing you want to do is damage it or get it so stuck that you can’t get it out. There is times when full power is needed but they are few and far between, you will know when you need to power down so to get yourself across a tricky bit of ground.

You also need to learn how to read the ground because if you can’t read the ground ahead of you then you will not know which gear and speed to go over it. But above all to be kind to your vehicle. This will only come with experience and you can only get this by going out and trying it, slowly, slowly at first then you can get a bit more adventurous.

**A FEW DONTS**

- Don’t switch between high and low ratio on the move
- Don’t apply the handbrake while the vehicle is still moving
- Don’t allow the engine to labour in too high a gear
- Don’t use the clutch as a foot rest. Keep the left foot well away from the clutch while the vehicle is in motion.
- Don’t change gear in deep water
- Don’t trust your brakes(handbrake as well) after being in water
- Don’t engage selectable 4WD on the road unless there is no traction
- Don’t put thumbs inside of the steering wheel. If you hit a hump or hole it could swing around and damage your thumbs

- Don’t over load your vehicle for off-road use. In particular don’t place heavy loads on the roof
- Don’t assume that you are the only one on the track, always look out for others.
**BRAKING TECHNIQUES**

In a word, try not to. Brakes frequently fail to work the way you expect them to off road. Water, or more especially mud, can play havoc with even the finest braking system. If your vehicle is fitted with ABS, you may also find other surprises in store for you.

**ENGINE BRAKING**

By far the best method is to use the engine to provide the major braking effort for you. Most 4WDs have gears sufficiently low to allow a controlled decent on the steepest of hills. If absolutely necessary a very gentle application of the brakes using the method below can be used to assist.

Before you begin a steep decent, select a gear you believe will be low enough to control your rate of decent without being too low. Then simply take both your feet off the pedals, and rest them flat on the floor.

On a slippery surface too low a gear can be as bad as applying the brakes, leading to quite an exciting time and too high a gear will result in you having to use the brakes so be sure before you commit yourself over the edge.

**CADENCE BRAKING**

If you slam on your brakes to slow down or stop when you are on a slippery surface, your wheels will lock up and you will start to slide. If you must apply the brakes, cadence braking should be employed. Apply the brakes briefly but sharply, and then release them. Repeat the process as rapidly as you can, but try if at all possible to avoid locking the wheels. The theory behind this technique is to allow the wheels to gain grip and use the grip to gain a modicum of braking. The process is the same as ABS but done by you and a lot slower.

**ABS**

More and more vehicles are being fitted with ABS systems these days, and incorporated with that is the traction control or hill decent control. You will find these on the majority of all land rovers these days. How they work is simple, as you apply the brake pedal the sensors apply the brakes but they
don’t just clamp on the pads to the discs they are applied on and off very fast so that they don’t lock the wheels therefore giving you a more controlled and safer stopping performance. HDC uses the ABS in this way by using the brakes to slow the vehicle down when descending hills so that you don’t need to brake. Traction control also uses the ABS to slow the spinning wheel therefore giving the wheel with traction more grip and the spinning wheel chance to gain grip as you drive forward over the slipperier area.
**TRACK SURFACES**

Every surface is different and characteristics can change within a few meters. Even the humble gravel road can vary depending on the type of gravel, its depth, method of construction and the underlying surface.

Muds vary from thin slimy coatings to deep wallowing pools. The texture varies according to the local soil structure.

**GRAVEL**

If you have ever done any serious driving on gravel roads, be prepared for a whole new experience. Take it easy until you become accustomed to the handling, especially on corners and hills.

If the road is flat, then where you travel is not that important (except when others are on it). If however, the road has a raised centre, travelling along the side can be quite difficult. The vehicle will tend to veer off course and the faster you are travelling the more pronounced the effect. Trying to take a corner at speed in this situation is asking for trouble.

Braking is likewise affected and in some cases can cause you to lose control, especially on bends or crowns of a slope, and can lead you to roll from one side to another and possibly roll the vehicle.

Another problem can be corrugations; these are caused by speed and braking over a number of years. The effect that this has on the vehicle is that it seems that you are floating on the surface, and thus hardly any contact between the road wheels and the ground. So the slower the better, but too slow and you will find that the vehicle will be shaken to bits, the same as going too fast but then when you need to brake you will feel like you’re on ice, you should not just slam on your brakes, and should use the cadence form of braking in this situation.

**MUD**

Mud for many an off-roader this is the essence of off-roading. Since most mud is found in flat areas, or in small hollows on a hill side, it’s usually (but not always) safe to tackle it. Mud on slopes is rarely deep and only the lack of traction can limit our progress. In other areas the type of mud and its depth will dictate whether or not you can cross it safely. The worse that can happen is that you get stuck. What you have to decide is whether you go round it or through it. If you’re on your own with limited recovery assets then air on the edge of caution. If the mud is more than 25cm deep then the most aggressive mud terrain tyres will have trouble getting through it. Thinner mud of a lighter consistency may present no more of an obstacle than water, but even water has mud at the bottom so always be aware of what you’re crossing.

You will gain experience of mud through trying it out. You will find out through practice what mud type requires what gear, as with all terrains the wrong gear can see you getting stuck.

Another way to aid your way through the mud is to reduce your tyre pressures so that your footprint is greater, therefore placing more of your tyre on the surface and gaining more traction.
SAND
I could almost fill the rest of the book on this subject, but I won’t.

Sand comes in all sorts, ranging from very fine dust type to the big grain type that you may find on the builders yard. Beach sands are perhaps the simplest, with only three basic types. There is soft, fine, dry sand, which is totally impassable; firm damp sand providing good driving surfaces; and wet sand, which allows a vehicle to sink very rapidly.

River sands vary considerably, even in the same stretch of river. Still, deep waters allow the accumulation of fine sand, just waiting to get you stuck. Fast flowing shallow water usually has a firm and well compacted base.

Dune formations may look like the 4WD playground, but there is one serious drawback. They are steeper than they look and have a steep drop off on the other side. The surface is usually soft and fine as it is always moving. In this type especially it is essential that you keep the momentum going, avoid hard braking as it will build up a ridge in front of the wheels and stop you from moving forward. Avoid sharp turns, again this will slow you down and have an effect on your progress, making you have to accelerate therefore increasing the risk of wheel spin and loss of traction and then you’re stuck. Reducing the pressure in your tyres will help with traction. Try to avoid changing gear if you’re slowing down, it’s better to stop and reverse along the tracks you have just made, and reverse out as far as you can so you can change your route.

ROCKS
Rocks, no surprise they are hard and unforgiving –if you drive into one or get stuck driving over one, you risk serious damage to your vehicle. So when driving over rocks, whether they are of the Sharp Mountain or smooth river type, you need to pay close attention to your vehicles ground clearance and the steepness of any ridges or ditches. Sharp rocks also put your tyres at risk of damage.

It is important that you check your route before crossing. If necessary try to fill in some of the deeper holes with small rocks to smooth out the route.

To save your tyres from as much damage as possible, you can raise the pressure up by at least a 1/3rd (normal TP30 psi - 40 psi). This hardens the side walls so that they don’t bulge out as much and get cut on sharp edges as you pass over the rocks.

If the rocks are unavoidable and you have to cross them the best way is to go dead slow. approach them on tick—over 1st gear low box. If you need to cross a rock then remember that you also have to come off it twice, once with the front wheel then with the rear wheel. What could get damaged are the wish bones, sills, axles, tyres and towing brackets. So slowly, slowly is the way ahead when crossing rocks and boulders.
TACKLING THE TERRAIN

As we said at the beginning, every 4WD, no matter how high it rides, has its limits to its ground clearance and to the depth of water it can drive through. You will need to develop a sense of what those limits are for your vehicle. In general, the biggest wheels and the shortest wheelbase give the best ground clearance. Short wheelbase vehicles are also able to turn more tightly than long wheelbase vehicles, making them more manoeuvrable.

Remember that the ground clearance doesn’t remain constant. If you drive over a hump, the front wheels will be on the one side while the rear will be the other. If the hump is steep enough you may get grounded on it and turn into a seesaw, with all four wheels hanging in the air. The technical term for what rules whether or not you will get stuck is the ‘ramp angle’ and is measured from the centre of the chassis to the front and rear wheels.

If you think an obstacle or a tricky piece of ground is about to test your vehicle’s limits, get out and check it on foot first. This way you will be able to find the best route, and also find any particular hazards that you need to avoid. If the obstacle is a mud hole or a stream, put your willies on and go for a paddle. Prodding with a stick will tell you how deep the water is, and whether the bottom is firm or soft, rocky or smooth,
**MARSHALLING**

If the obstacle is rough terrain, ask someone to guide you over or around it. If they place themselves in front where they can see all 4 wheels and be able to see under the vehicle for ground clearance, this will make their job easier and yours to get across the obstacle or obstacles remember if you think you need help then you probably do.

**HILLS**

As in all tough off-road challenges, get out of the vehicle and go on foot to assess the hill you are about to climb. Check the ramp break over, departure and approach angles and work out whether your vehicle is likely to get grounded at the foot of the hill (this is where both the front and the rear can dig in) or at the top (where the middle could get grounded). Remember that a long wheelbase vehicle is more likely to have more problems in this area than a shorter wheelbase type vehicle. Likewise, skirted body kit at the front of the vehicle could get damaged on the approach.
Examine the hill for potholes, tree roots and ruts. Is there anywhere that you may get into a cross axle situation? (Say your front off side wheel drops into a hole/rut at the same time as your rear near side wheel dose the same) you will get stuck.

Now look at the surface. Is it loose sand, hard rock, soft mud, fresh grass or firm soil? Is it wet or dry? In winter are there icy patches or puddles.

Next you need to determine how steep it is. What gear you will need what type of tyres you have on your vehicle, diff lock options, if you are unsure of any of the above points then don’t attempt the hill.

If you have calculated all the above and you are happy to proceed then I suggest that as a new driver that you make your first attempt in 1st gear, low box and diff lock on. If you fail the hill then follow this procedure

1. Stop the vehicle using the brake and clutch.
2. Engage reverse gear.
3. Ensure that your front wheels are straight.
4. Slowly and carefully reverse back, using engine braking to slow you down.
5. Do not attempt to apply the clutch once you are moving back down the hill.

Once at the bottom then you may wish to attempt the hill again this time in 2nd gear, slowly build your speed up at the base and increase the speed as you climb. Don’t be fooled into thinking that you need to attack the hill like an idiot at full speed you will only damage your vehicle or worse yourself.

A useful phrase to remember is GGCOE, ground, gradient, course, obstacles and emergency

This works for all types of situation that you may come across.

**IF YOU CAN NOT WALK IT THEN DONT DRIVE IT!!!!!!**
THE DESCENT

Before you go downhill you need to park safely in a sensible position before you again assess the situation on foot. The same considerations apply as the hill climb with regard to the ground type, potholes, etc. although in this case you’re looking for a situation where you could lose control.

On most vehicles you will be relying on the vehicle’s engine braking effect of first gear and low box. You may have hill descent control or ABS fitted, but neither will prevent your wheels from slipping if you hit soft gravel, ice or wet rocks.

If in any doubt don’t attempt the descent. If you’re on a track or byways ensure that the hill can be climbed as you may have to return that way.

If you have calculated all the above and you are happy to proceed then I suggest that you follow this procedure:

1. Engage first gear.
2. Low box.
3. Diff lock on.
4. Not front diff locks.
5. Ensure that your wheels are pointing straight and are at right angles to the ridge.
6. As you line up the vehicle you are facing the natural line of the hill.
7. As you approach the descent hold the steering wheel firmly in the 10 to 2 position.
8. Take your foot off the clutch and allow your right foot to hover over the brake and accelerator just in case you need to cadence brake or accelerate, if the vehicle starts to slide.
9. Ideally you should not be touching the brakes or the clutch pedals.

Again as you gain confidence in descending hills etc you will be able to try different type of hill, but always with the safety in mind.

AGAIN IF YOU CAN NOT WALK IT THEN DONT DRIVE IT!!!!!!
SIDE SLOPES OR TRAVERSING

As a general rule of thumb don't drive across side slopes if you don't have to, find another route. If you do have to cross a slope, because your route selection is not as good as you thought it was then you should do the following. Driving a steep side slope is always a thing that will possibly daunt a new driver to off roading, it may not look to bad from the outside but from behind the wheel is a different matter. It's also one of the most dangerous operations that you can do off road, you're most at risk of rolling over carrying out this operation. If you have to drive a side slope then, again get out of the vehicle and do a ground appreciation of your route across the slope. Look carefully for any obstacle that may impede your travel across the slope, such as rocks, pot holes, ice, wet grass or tree roots that are above ground that when you put your wheels on them make you slide to one side. If there are no obstacles then look for an escape route in case you do anything wrong or the ground gives way as you are crossing. There is another factor that can affect your decision to cross a slope and that is your vehicles centre of gravity the lower the better, so if you have a roof rack loaded up then you should consider taking the load off and placing it inside the vehicle evenly on the floor space to keep it as low as possible. Also ask your passengers to get out so they can follow on foot, this has two benefits, 1 you reduce the risk of injury if anything goes wrong, 2 it reduces that weight, so making it a lower centre of gravity. Also ensure that any kit stowed in the vehicle is tied down so it does not slide about and move.

When you're ready to cross then you need to engage 1st gear, low box and diff locks on to give you the maximum grip crossing, drive slowly across the slope and resist the urge to speed up to get across quicker as this may have an adverse affect on the crossing. If your vehicle starts to slide then try not to correct it by turning up the hill, as it's telling you that it is not managing to gain grip and therefore needs to come off the slope. So steer down the slope and re-assess the crossing. If you do turn up the hill then you are increasing the side angle of the vehicle and may possibly roll over. So the rules are

1. Don't cross slopes if you don't need to.
2. Keep the centre of gravity as low as possible.
3. Remove passengers.
4. Tie down kit securely.
5. Use 1st gear, low box, diff locks
6. Don't turn up hill if you slide.
7. Escape routes downhill.
If you are traversing a slope and feel your vehicle to be about to tip, turn quickly and accelerate down the slope.
**DITCHES AND BANKS**

As with all we have been talking about so far we need to get out of our vehicle and check the ground that we are about to cross.

Ditches are common place in the world of off roading and they need to be crossed if we are going to continue on a set route. The problem with crossing a ditch is that we will lose traction and therefore lose momentum and end up getting stuck. The best way to avoid this is to only cross a ditch that is within the means of our vehicle, unless we have bridging aids and more experience in off roading.

Having said this most 4x4s will easily cross over ditches if it’s done right.

With diff lock engaged and only one wheel over the ditch (and not in contact with the ground) at any stage; you can ease yourself over what appears to be an impassable challenge. But you must avoid getting cross axle, which with a land rover with centre diff means making sure that there are never two diagonally opposite wheels not in contact with the ground at any time. To achieve this, approach the ditch in 1st or 2nd gear, low box with diff lock engaged, at an angle of between 30 and 40 degrees. The width of the ditch will affect the amount of throttle needed. You may need plenty of momentum to keep you moving, as you are both pushing and pulling your way across the ditch. Just remember that when your front wheels come into contact with the ground, there will be resistance so hold tight to the steering wheel and keep them facing the way they should be. Thumbs out!
**WADING**

Wading is when you have to cross an expanse of water on your route, yet again if you don’t need to do it then choose another route.

This is where you don’t want to get out of your vehicle to check your route, but yet again you need to park up in a safe place and put your willies on because you need to walk the route through the water. The first thing that needs to be done is to sort out your entry point, this needs to be accessible in both directions as if you need to retrace your route then you can get out again. It needs to be a gentle slope in so that you’re not dropping off a ledge into the water. Next you need to test the path that you are going to take, this is done by walking the entire length of the crossing and back again the full width plus ½ of your vehicle, this should be done with the aid of a stick for you to stabilise yourself and test the ground in front of you, as you cross so that you are sure that there is no underwater obstructions that you may get snagged up on. As you get to the other side of the water on the 1st pass then you need to be looking for an easy way out of it, again these needs to be as a gentle a slope as possible to aid your exit from the water. Once you have assessed the depth, obstructions, entry, exit and flow of the water. The flow is very important in assessing your crossing as I will go into later in this section.

The depth must not be over the manufactures recommendations, on the majority of 4x4s it is about 0.5M but you should always check your hand book.

Course should be marked so that when you drive it you know where to go and not detour off the assed route and get snagged up on something that you don’t know about.

The speed of the water or current should be taken into account before you cross. Again you should only be crossing up to the manufactures recommendations on wading depth so as a general rule of thumb if the water is flowing fast and is not above the wheel rims then it should be safe to cross, if the water is deeper then you should have a prepared vehicle and only cross after you are more experienced in this art of off road driving.

You have now assessed your route, now you have to sort your vehicle out ready for the crossing, is it petrol or diesel, diesel engines are better when it comes to wading than petrol engines, as petrol engines need to be water proofed before entering water, such as the HT leads, plugs, etc. you also need to cover the radiator with a sheet of plastic or jacket to prevent water coming through and being thrown around the engine bay by the fan and soaking the electrics.

The most damaging aspects of wading are water going into the air intake, (a raised air intake will help) and up the exhaust pipe if you stall in the water and try to re-start the engine.

How to cross the water, now you have taken into account of all the above then approach the water slowly. 2nd gear, low box and diff lock on, and then accelerate to form a bow wave in front of the vehicle. The bow wave is important because it will form a trough behind it that keeps the water level below the engine bay as shallow as possible. If you go to fast then the water will come up over the bonnet and windscreen obscuring your view and forcing water into the engine bay.
Rules for wading:

1. Recce the entry, exit, route before you cross
2. Cover up electrics if in a petrol motor
3. Enter slowly in 2nd gear, low box and diff lock on
4. Make a bow wave and keep it in front of you
5. Don’t exceed the wading depth of your vehicle
6. If you stall the engine DON'T re-start it in the water

An inspection on foot is especially important in rivers where hazards are hidden.
**RECOVERY TECHNIQUES**

Despite all the best advice and prep, you may get stuck fast. Now what?

Getting stuck is part and parcel of off-roading; you should have with you all the necessary equipment you need to get you out. If you are on your own then you definitely should have all that you need to get yourself out unaided.

But if in a group then 9 times in 10 all you will need is a tow rope to get you on the move again.

**SURVEY THE SCENE**

The first thing you need to do is to look at why you are stuck. It may be pretty obvious if you have just driven into a mud bog and gone up to your axles. Neither the less it’s quite amazing how many times that a log or rock gets in the way of a straight forward recovery. If the obstruction is in front of you and you can’t move it then the only option to you is to recover back the way you came even if you only have 3 foot forward and 200 foot backwards. It’s the nature of the beast. But if extraction back the way you came is not possible then you may have try and dig the obstruction out or raise your vehicle over it, only you can make that decision on the ground.

**TOWING**

Towing can be all you need some times to get you out from that sticky situation. Be aware though that you’re not over loading the tow rope or anchoring it unsafely.

The rope or strop should be rated to the same as your vehicle or above. Not be old and worn, so the time that you need it, it just snaps.

Again ware you anchoring point is secure and not going to come off. If you have to wrap it around the bumper be aware that it may get cut on the edges and fail, or it could just rip the bumper off under tension.

One on one pull forwards or backwards is fairly straight forward. You need to ensure that both vehicles are working together; if necessary have a marshal there to do the controlling.

Pulling forwards is the usual method for a quick pull out or over an obstacle as long as you can get in close enough to do so.

Pulling backwards is used when you can’t get in front of the stuck vehicle and the only option is to return the way you came, it is also easier as you are using the existing tracks made on the route into the boggy area than pulling against it.

Sometimes you may have to put in a tandem pull; this is when you hook up two vehicles to pull one out as seen below
SNATCHING
Should a tow not be enough then you may have to snatch at the stuck vehicle to get it moving, you will need a special rope for this as a row rope or strop will not do the job as they are designed to tow and not be snatched? The rope that you will need is a kinetic rope or elasticized rope. These ropes have a stretchy quality built in them and are for snatch recovery only and are designed not to damage the vehicles that are pulling on them, so the take the pressure of the snatch and not the vehicles. You will need training in the use of these before using them as there is a safety aspect in this type of recovery. So seek training first.
WHAT TO DO

1. Attach the rope and drive the towing vehicle forward until you have taken up any slack.
2. Reverse the towing vehicle a short distance to allow a run up.
3. Using low ratio second gear, accelerate strongly to stretch the rope and, all going well, pop the stuck vehicle free.
4. If the stuck vehicle doesn’t move dig around it before trying again. You may need to couple another vehicle in tandem or beside so you have more power to pull it free.

Remember with all types of towing and snatching keep bystanders away whilst carrying out the operation.
JOINING ROPES AND STRAPS
At some stage you may have to connect two ropes or strops together. Do not knott them as with the pressure of the pull you won’t get them apart again. There are two methods that can be used, 1st is using a bow shackle and the 2nd is using a bit of wood a branch etc.
WINCHING

If the snatching technique does not work (or you’re on your own) then some form of winching may have to be used.

GENERAL NOTES ON WINCHING

- Don’t wait until it’s too late to learn how to winch, there are two ways to do this 1st is to read the instructions (not a man thing to do I know) but it needs to be done if you want to use the winch safely. Practise yourself on firm ground and practise the different techniques before going off on the adventure. 2nd is to go to a company that specialise in off roading courses, they will be able to give you the correct tuition that is required and then if you pass the course give you the qualification as is required for the training that you have done.

- No matter what type of winch you have, whether it is a PTO, electric or hydraulic winch, once the rope is attached to the stuck vehicle keep all bystanders well clear unless they are involved in the operation. Never stand near or astride the cable. Different precautions need to be taken with the different types of cable (wire or synthetic ropes).

- If practicable the stuck vehicle should give assistance by driving whilst being winched in.

- Use a suitable anchor point. These can range from trees, rocks, vehicles and ground anchors (many types are on the market and the home made type made out on the ground).

USING ANOTHER VEHICLE

If you do use another vehicle as an anchor you could end up moving it to you instead of you moving to it. In this case you need to find a way of securing it. You can use two or three vehicles together or if you only have the one available then there are other methods, such as in the picture here.
USING TREES

Never just wrap your winch cable around a tree. Not only will this kill the tree, it can also damage the cable, and it also lowers the strength of the cable.

Use a tree protector (a wide webbing sling) you should invest in one of these as you should be abiding by the country code.
If you don’t have a tree protector then a strop can be used, or even a chain with a piece of carpet wrapped around the tree first.

As a last resort then you could use a cable with sticks to protect the tree, wrap the cable around a couple of times so as not to induce a tourniquet effect on the tree. This could damage both the tree and your cable.
Always position your anchor point as low to the bottom of the trunk as possible. The general rule of thumb is diameter -max height up the trunk. Be aware of trees growing on rocky ground as their roots will be very shallow and the tree my not take a lot of pulling pressure.
GROUND ANCHORS

Ground anchors come in many shapes and sizes. Available from most 4x4 accessory outlets, they can involve some kind of corkscrew to be driven into the ground with a support plate at ground level. However these can be very expensive, bulky, heavy and difficult to put into the ground. You can fabricate an excellent ground anchor at home, using a strip 5x75mm steel with holes drilled in at regular intervals. As an alternative you can use your high lift jack on its side and place the pins through the holes in the central casing and a bow shackle can be fitted at the end hole for the winch hook.

Don’t despair if you don’t have one of these with you, you have a spare wheel with you? Or you should.

The wheel can be used as the centre for a very effective anchor, with two possible variations. Firstly you can attach a chain or the cable to the spare and bury it! If you can dig it deep enough this arrangement will take quite a lot of load, depending on the texture of the ground. For the best effect the wheel should be buried vertical of sloping backwards slightly and the cable should be passed through the centre of the wheel and attached to a bar or log so it sits across the wheel. The cable should be kept in as a straight line as possible passing to the surface via a trench to the vehicle.
As an alternative, place the wheel on the ground (or better partially bury it) and drive a series of stakes around it (the more the better). The stakes should be tied together at the top to form a wigwam shape. Attach the cable to the wheel using a chain, but be prepared to take it easy with the winching.

THE SNATCH BLOCK

The snatch block or pulley block is a very versatile piece of kit. It enables you to change the direction of pull, if you can’t get it all lined up correctly. To double the pulling power of the winch attach the pulley block to the anchor point and run the rope though it and back to your vehicle, you will of course need double the length of cable. It can help pull around corners; this is usually when you are pulling someone else.

You can increase the winch pulling power with the snatch block as shown and this is called a 2–1 pull or 3–1 pulls.

And for winching around corners, set it up like this.
And what if your winch is at the front and you need it the other end, well there is a way.

You need some extra snatch blocks, usually 4 will do, you can’t have too many, it’s still cheaper than another winch at the rear.

1st lay out the cable as shown, run forward to the 1st snatch block. From here, the cable passes under the vehicle to the 2nd snatch block some way behind the vehicle. Now bring the cable back to the 3rd snatch block on the back of the vehicle, pass the cable around that and back to the 4th snatch block which is at the same place as the 2nd snatch block, then pass the cable around the 4th and back to the vehicle. Now we have what looks a very complex set up. It isn’t if you think about it, follow the cable and you will see that it will do the job with a 3:1 ratio which is more than adequate to pull you backwards.
KEEPING IT ALL TOGETHER

To control the winch operation so that everyone knows what to do and when to do it. We have hand signals, but you don’t necessarily need to use them if the set up is a fare distance apart or around a corner you can use radios and relay your instructions that way.

TAKE IN  LET OUT  HOLD  STOP

Take in, raise your arm and make a circling motion with your hand.
Let out, lower your arm and make a circling motion with your hand.
Hold, arm up fist clenched to hold the proceedings or rest.
Stop, both arms up and crossed this means STOP everything now.

FEEDING IN THE CABLE

If after you have recovered yourself the cable is not all the way in on the drum or it’s all wrapped on the drum to one side or untidy then you are going to have to lay the cable on the drum properly.
First of all pull the cable out, be aware if it is wire cable you need to be wearing good gloves.
Ok with the cable out you can now load it back on, you need it to be under load if possible, but if not then winch in and pass the cable hand over hand, don’t let it run through your hands or have it wrapped around them. Most winches will load evenly if the cable is fed in the centre of the fairlead.
Ensure that the cable won’t get snagged on anything as you load it on the drum.
Remember to keep control of the speed and rate that the winch is being wound. Also keep your hands well away from the fairlead at least 1 meter/ 3 foot, the last thing you want is your hand being pulled into the winch as it makes a mess.

OTHER FORMS OF WINCHING

The high lift jack is a very versatile device and can be used as a short haul winch. As long as you have the energy, there is really no limit to the distance you can haul a vehicle. However, in practice it is unlikely to be more than a few yards. The majority of recovery operations will involve moving a stuck vehicle less than a meter or so. You should never use a flexible or stretch–type strop as an anchor in this situation as it will stretch without moving the vehicle. Use chains and wire ropes instead.
When it’s at the end of travel, release the tension from the lifting foot and return it to its base. Reconnect the chain to the lifting foot and continue as for step 1.

SAFETY FACTORS

Vehicle recovery is dangerous. Broken ropes, shackles, hooks, chains and blocks can kill.

- Never stand near recovery tackle that is under load.
- Do not let children or animals get close— their natural curiosity may prove fatal.
- Only the people directly concerned with the recovery should be near the vehicles. Everybody else should be at least 50m away and not in line with any rope. Some danger areas are shown below.