Figure 12-14 Laura Waddington's *Border* (2004) is shot almost entirely at night using a mix of headlights at dusk (left), on-camera light (center), and available light (right).

END BOX

EXPOSURE: BEYOND THE BASICS

Now that you are familiar with the issues that come up when lighting a scene, we can turn our attention to slightly more intricate issues related to lighting your scene, and the interpretation of that light through the camera's electronics. We need to look a little closer at how the sensor actually responds to the various light values in a scene, beyond just its general sensitivity. Three additional concepts are essential to a more advanced understanding of lighting and exposure for video: **contrast range**, **characteristic exposure curve**, and **dynamic range**.

Contrast range

Contrast range, also called "luminance range**,"** is the difference between the brightest and the darkest areas of the scene you are shooting. Remember, "bright" and "dark" consist of a combination of incident light intensity and reflected light values (**p. xx**). Even in a high-key scene there will be tremendous variations in light levels. Contrast range can be expressed either in terms of a ratio, or in terms of the difference in f-stops between the two luminance extremes. For example, it is not unusual to discover, through multiple light meter readings, that a scene's lightest area is 16 times brighter than its darkest area. We can express this as a contrast *ratio* of 16:1 or as a contrast *range* of four f-stops. Why? Remember that each stop is a halving or doubling of brightness, so four stops from darkest to brightest is 2 × 2 × 2 × 2 = 16. If the darkest area of your image reads 20 foot-candles, then the brightest parts will read 320 foot-candles. It should be noted that four stops is a relatively narrow contrast range. It's not unusual to have a contrast range of 256:1 (8 f-stops) or even more (**Figure 12-15**). One central question concerns how much of this contrast range your camera's sensor can faithfully reproduce.

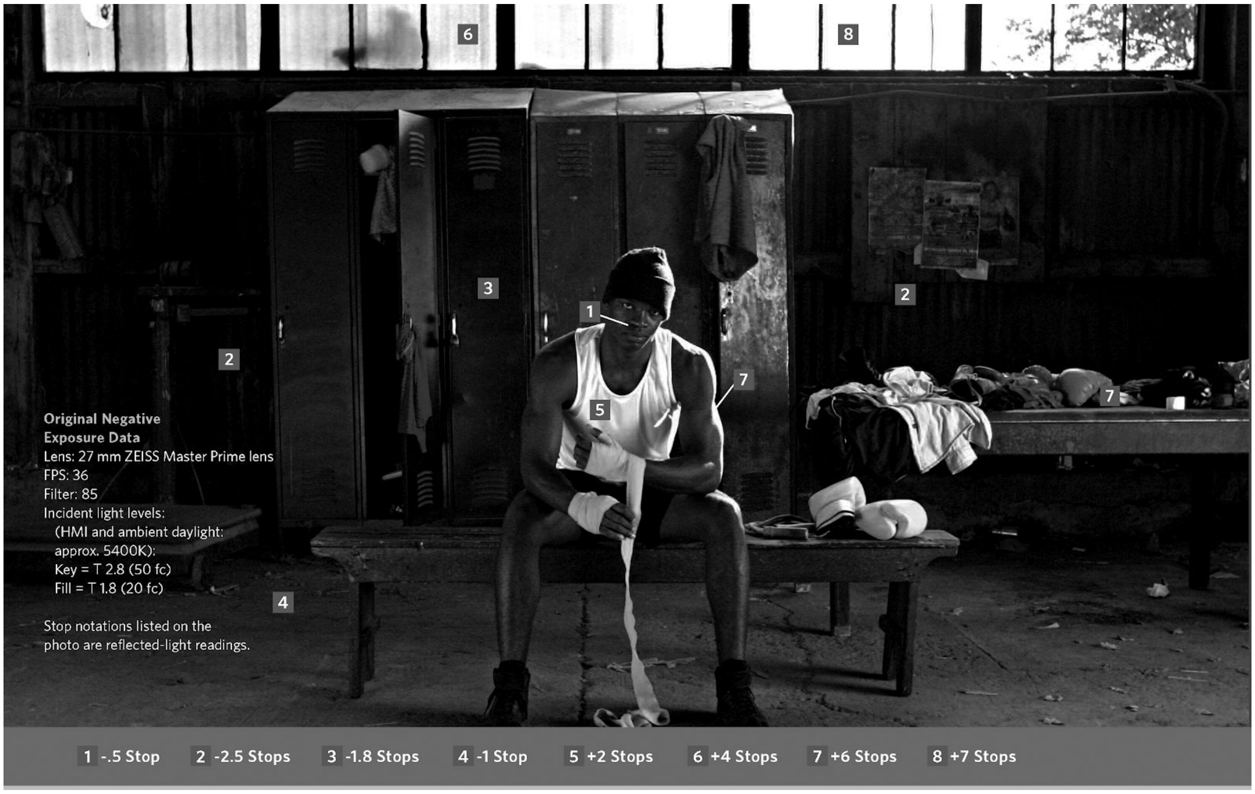


Figure 12-15 Film is still the gold standard for its ability to handle contrast in an image. This scene from Kodak shows the contrast range in f-stops, from the dark wall to the left of the lockers (-2.5 stops) to the bright windows above (+7 stops) of their Vision 3 500T negative stock, a total of 7.5 stops.

Dynamic Range

Broadly defined, **exposure range** (sometimes called **dynamic range**) is the range of luminance values your specific imaging device can render with detail before falling off into complete overexposure (**blown out** or **clipped whites**) or complete underexposure (**crushed blacks**), where no image detail is visible. Exposure range is expressed in terms of the range of f-stops within which the imaging device will see detail. It is often the case that the contrast range of a scene exceeds the exposure range of your imaging device, which means that visual detail will be lost either in the brightest or darkest parts of your scene, or both. Cameras vary in their ability to render detail in bright or dark areas of the image. For example, an inexpensive consumer video camera can handle 7 or 8 stops, while a higher-end camera like Sony's A7S can handle about 12 stops. So if you want to truly control your image, it's important to know both the contrast range of the scene you are shooting and the ability of your imaging device to render those exposure values. Once you know these facts, you can use camera controls and lighting to selectively bring areas of your scene into or out of the exposure range of your imaging device to create visual emphasis and interest.

In addition to the camera's ability to record a broad range of light levels, there is its ability to monitor those levels. In many cameras the viewfinder, particularly if it is a flip-out LCD viewscreen, deals with contrast poorly. For this reason, many cinematographers will use a good-quality field monitor to give a better idea of what is going on with the lighting.

Shooting with dynamic range in mind

As we've suggested, dynamic range refers to the camera's ability to reproduce light and dark aspects of a scene. When looking at a real situation, you will have to make choices about what is important to you in the scene. Do you care about the shadow detail, like the folds in a dark garment, or the curls in someone's dark hair? If so, you can open up your aperture and let the highlights in the scene be overexposed. If what is happening in the brighter parts of the image are important to you, like how the clouds look in the sky, then you can stop down and sacrifice the detail in the shadow areas.

Although there are specific limits to what a particular camera can do, the ability of sensors to handle wide dynamic range is improving regularly. The gold standard historically was film, where the dynamic range (expressed as **latitude**) could be as high as 14 stops. Because of the demand for digital cinematography to replace film, many manufacturers offer ways to extend the dynamic range of their video cameras. We will explore some of these options below.

Characteristic Curves and Gamma

In addition to the range the camera can handle, there are significant differences in the ways different cameras reproduce the light within that range. For example two cameras might have the same range of 8 stops, but respond quite differently. That difference is represented graphically in the **characteristic curve** (**Figure 12-16**). In a sense the characteristic curve represents a camera's personality, how the sensor responds to the light hitting it. Imagine a medium level gray that a camera sees. It can represent that gray as it is, or as a bit darker or lighter. Another camera will respond differently. These differences in characteristic curve mean that one camera may offer more shades of gray at the dark end, adding shadow detail, while another may show more of the differences in highlights. This can be a bit complicated at first, and It is much easier to visualize when you actually start comparing cameras.

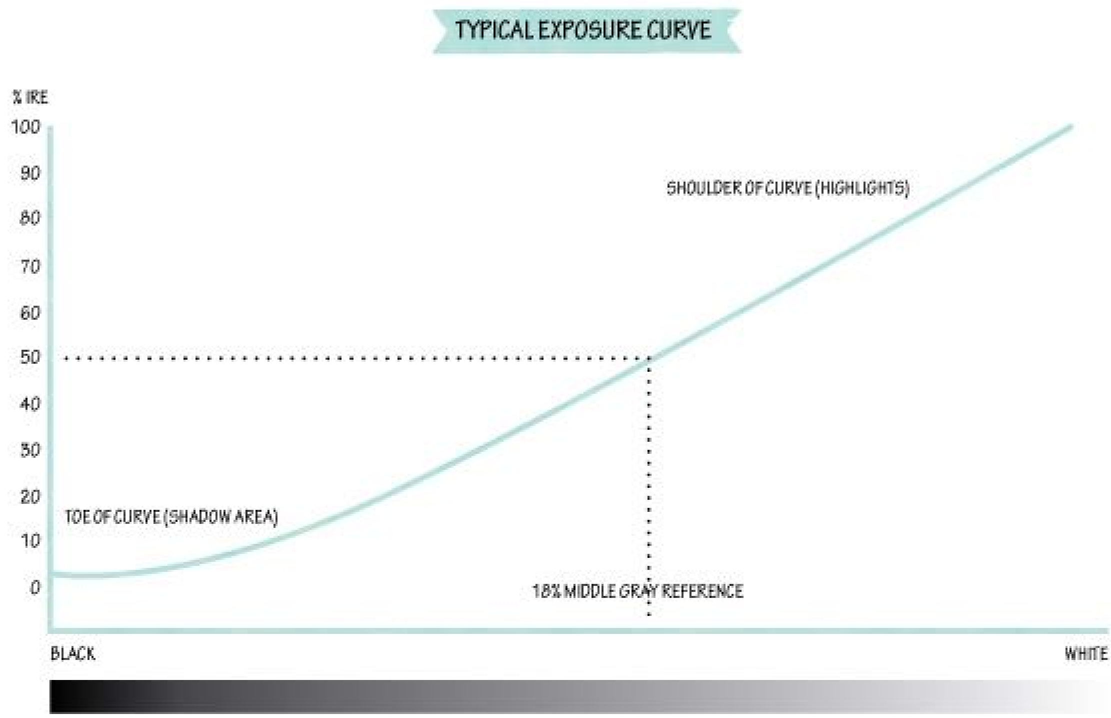
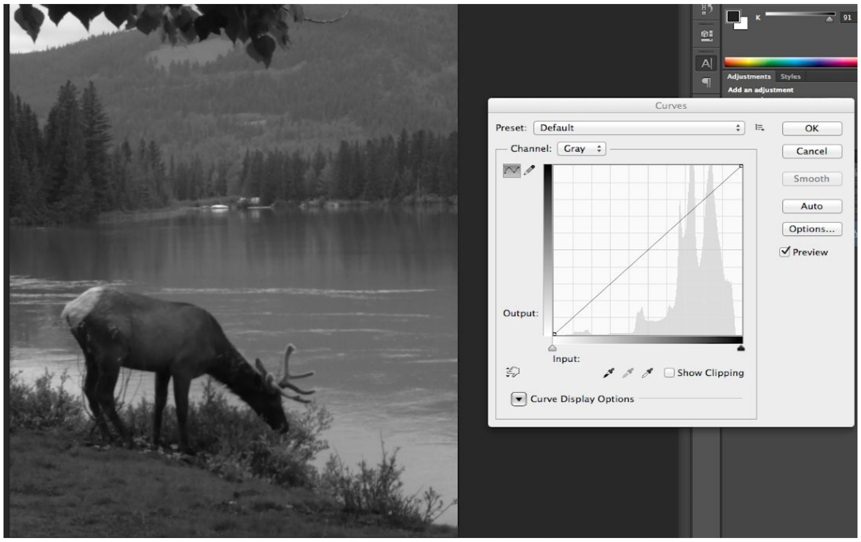
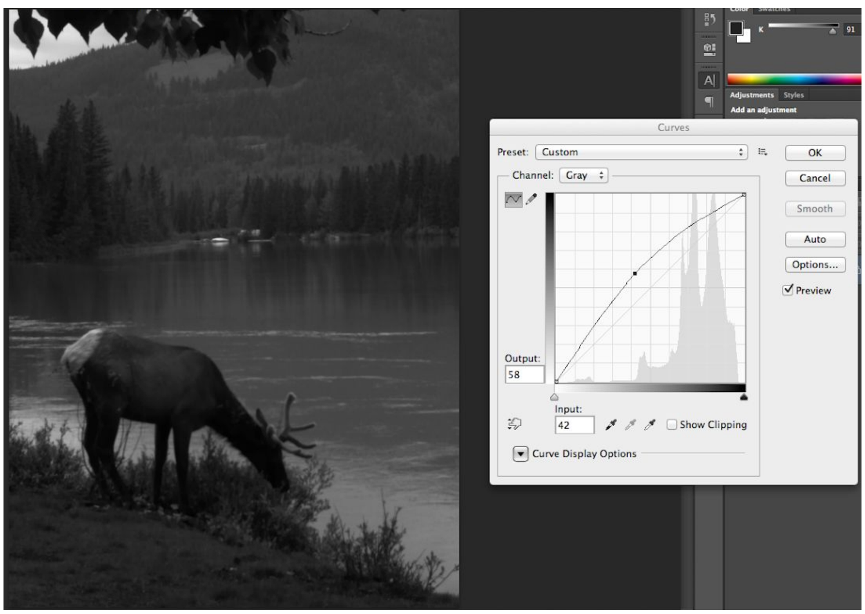


Figure 12-16 This figure shows a characteristic curve for a video image. The Y axis represents the light in the scene from dark on the left through a medium 18% grey to a bright 100% white on the right. This represents the input, or the light entering the camera. On the x (horizontal) axis you can see the output, the amount of luminance in IRE units generated by the camera in response to this incoming light. The slight curve at the bottom of the image is the "toe" and indicates that the shadow detail falls off gently. The lack of a curve at the top or white end suggests that there will be no emphasis on detail in the white part of the exposure curve.

In many cameras you can influence the characteristic curve of the camera's imaging by changing settings, most notably the **gamma**. Gamma represents the capacity of an imager to differentiate between the various luminance tonalities (shades of gray) in a scene and is represented by the angle of the straight-line portion of the curve — in other words, the steepness of the slope. The ideal angle for a straight line would be a perfect 45°, meaning a perfectly proportional increase in density to exposure. This would faithfully duplicate all of the subtle shifts in the gray scale (**Figure 12-17**). However, the human eye does not work the way a video sensor does, so a "perfect curve" doesn't necessarily look pleasing to the viewer.


Adjustments
Styles
Add an adjustment
Curves
Preset: Default
OK
Channel: Gray
Cancel
Smooth
Auto
Options...
Preview
Output:
Input:
Show Clipping
Curve Display Options


Adjustments
Styles
Add an adjustment
Curves
Preset: Custom
OK
Channel: Gray
Cancel
Smooth
Auto
Options...
Preview
Output:
58
Input:
42
Show Clipping
Curve Display Options

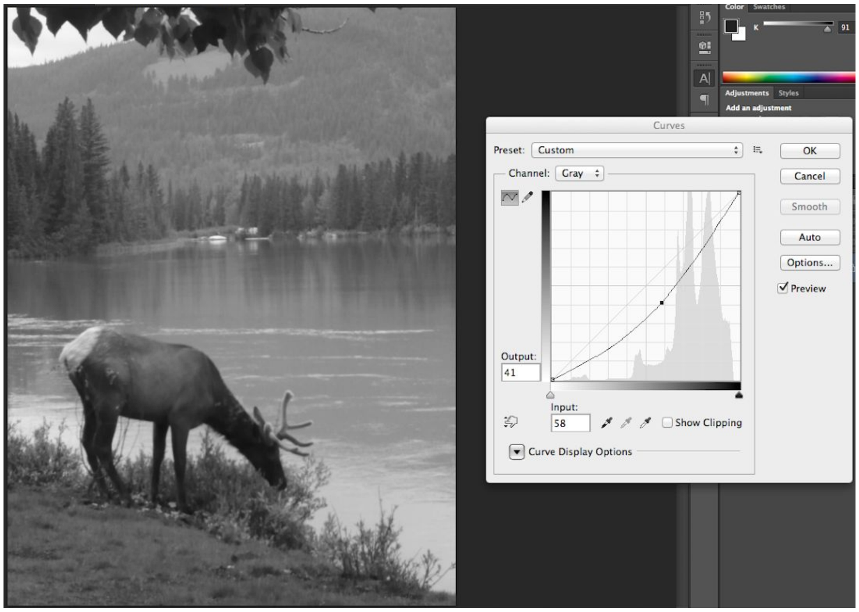


Figure 12-17 Here the same still image is shown with no changes in gamma (top), with a gamma curve that minimizes contrast in the midrange (middle) and one that emphasizes contrast (bottom). The graph next to the picture represents the characteristic curve for each image.

Changing your camera's gamma setting allows you to choose which part of the curve you want to expand or compress. Canon, for example, offers nine different gamma settings. Cine 1 "softens the contrast in darker regions and emphasizes gradation changes in lighter regions," while Cine 3 provides a "stronger contrast between light and dark regions, and greater emphasis on black gradation changes."

Black Stretch, Knee and Log Gamma

An additional detail of the characteristic curve that is greatly affected by the angle of the curve slope in the **toe** (the dark end of the curve) and the **shoulder** (the bright end). Video compression circuitry creates a signal with no toe and no shoulder, which means a hard clipping of whites and an abrupt plunge into inky blacks when the exposure approaches the extremes of under- and over-exposure. Without the curved toe and shoulder at the ends of the exposure limits of the imaging device, the video image not only fails to duplicate film's gradual tapering off of detail toward total black or total white, but it also loses out on a few stops of usable exposure range.

Black stretch is a setting that can extend the sensor's sensitivity in the darkest parts of the image so that you are able to see somewhat more detail in the shadow areas of the shot. Engaging black stretch is the equivalent of creating a "toe" in the characteristic curve. You will see a little taper to the extreme under-exposures which means that things at the darker end of the light range fade off gently, offering more shadow detail, and you gain about one stop at the bottom end. Black stretch is like a video gain function that selectively boosts only the darkest portions of the image. As with video gain, you need to be careful that you don't overdo black stretch because you can introduce video noise into an area that was otherwise clean, or you can create blacks that are not rich (called **milky blacks**) in all portions of your image that are black. Some of the work of black stretch can be more accurately and safely accomplished in two ways: careful lighting of the dark areas of the image (when you have lights) so that you bring those areas into your dynamic range or through post-production color correction (p. xx).

Video is especially vulnerable to over-exposures that commonly shows up in two circumstances: highlights on prominent areas of a subject that reflect the key light, like cheekbones or foreheads, and in situations of extreme contrast ratio, like bright windows visible in a dark interior location. This overexposure, called **clipping,** can be avoided by careful use of **zebras** (**Chapter 11**), but even without over-exposure bright highlights can cause an extreme and uneven loss of color saturation and detail in the image. **Video knee** is a signal compression adjustment that is the equivalent of creating a "shoulder" in the signal's response to intense exposures. Many HD cameras allow for manual setting of the upper signal levels (near the ultimate white clip level), allowing more detail to be visible as you approach total over-exposure. Attenuation of extreme white levels can be set at 80% (low), 90% (mid), and 100% (high). The earlier you set knee to kick in, the more detail you'll see in your highlights. The drawback is that setting knee at 80% can make your whites look gray. Many cameras now have an easily accessible automatic pre-knee setting, called **auto-knee** (also called **auto highlight control**), designed to give you maximum detail depending on the highlight values of the particular image in the frame. Auto-knee is one of the few auto settings that you might consider leaving on while you shoot, but it works best with static frames. A shot that pans across bright areas will reveal the processor adjusting as it detects highlights and corrects on the fly.

As mentioned above, many cameras now offer gamma settings that give video a more filmic look by softening the top and bottom of the exposure curves, meaning that the camera's exposure eases into shadow and highlight areas. One of the most common signal tweaking functions is **CineGamma.** CineGamma (a.k.a. Cine-like, Cinematone or Film Rec) electronically flattens the straight-line portion of the video signal's characteristic curve and introduces a shoulder to the highlight areas. This accomplishes two things simultaneously: it slightly extends the dynamic range of the camera, and reduces the contrast of the image, thus ameliorating video's"crispy" electronic look. With CineGamma, you'll see more detail in the shadows and highlights. The drawback of this setting is that the overall reduced contrast of the image can, in some cases, create washed out midtones and colors (**Figure 12-18**).

Figure 12-18 This woodsy yard is represented in three of the different gamma modes available on the Canon C100. The top image is standard mode, which looks fine but risks burning out the highlights, such as those on the bench in the foreground. The middle image was shot with Wide DR to add several stops to the exposure range. The image looks darker here, but has much more picture information in the highlights. The bottom image was shot in the Canon Log mode, creating an image that looks murky to the eye, but will respond well to color grading in post-production (p. xx).

Log gamma settings stretch the dynamic range of the image to the maximum the sensor is capable of, which can mean going from ten or eleven to twelve or more stops (**Figure 12-19**). The resulting image has lots of highlight and shadow detail, but looks flat and quite unnatural until it is corrected in post-production. In fact, another name for this approach is **shooting flat**. Shooting with log gamma means that your workflow in post-production will have to include **color grading** (**Chapter 22**). For documentary work, one alternative is an **extended dynamic range**

setting (Wide DR in this case), available on some cameras,that demands less work in post-production **(Figure 12-17, middle)**.

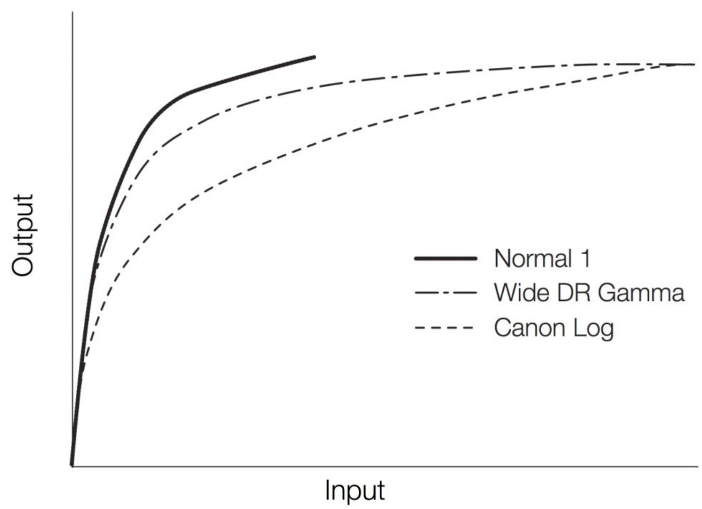


Figure 12-19 Log gamma (Canon Log in this case). Like many manufacturers, Canon offers two options to create a broader exposure range. Wide DR and Canon Log modes offer several extra f-stops, indicated by the longer curves.

Always use caution and moderation when you use any of these settings. Altering the electronic signal of your camera can have unintended consequences. If you're interested in using black stretch, video-knee, or CineGamma, make sure you shoot tests before going into production. Also remember that adjusting the signal is not a substitute for careful, sensitive, and creative attention to lighting and exposure.

Color Settings

Video cameras also typically have a color “look.” People will argue about the warmth of one camera’s image vs. the naturalness of another. Most cameras now have a variety of color settings which affect how the camera reproduces color. A discussion of these is outside the scope of this book, but if you have a particular idea about color reproduction, you should investigate these settings on your camera.

CONCLUSION

As you’ve seen, documentary lighting isn't just a matter of throwing light onto a scene so that we can make out the physical subject. Lighting is communicating visual ideas and inflecting the film with a mood, a tone, and a visual context. The approaches we’ve explored in this chapter should give you a solid sense of how you can get started creating the lighting approach that best suits the story you are telling.