# LandPKS Lesson 3: Land Management Planning – Teacher Guide

## *Program Summary*

In this three-lesson module, students become part of the LandPKS knowledge-sharing team.

- In lesson 1, students learn about the effects of climate, soil, topography, and plant characteristics on land potential. They receive an introduction to the indicators and how to assess them in the field.
- In lesson 2, students use the LandPKS apps to collect data on a site.
- In lesson 3, students use the LandPKS-generated Land Capability Classifications (LCCs) to learn how scientists, land managers, and city planners use this information. Students then make inferences about their own sites and how they are being utilized. Students use their new knowledge of LCCs to plan a solution to a land management dilemma.

## *Lesson 2 Summary*

In this final lesson of the module, students will use the data they collected in Lesson 2 to generate Land Capability Classifications (LCCs) using the LandPKS app. They will learn about and apply their new knowledge of LCCs to design a possible solution to a land management dilemma.

## *Student Age*

10 - 18

Note: this lesson is designed to align with standards for 5th grade and middle school students (generally age 10 – 14) as specified in the Next Generation Science Standards. However, the concepts and activities are relevant for older students and adults.

## *Objective*

- Use data from the LandPKS app to generate LCCs for their plots and apply what that means about their plot.
- Apply an understanding of LCCs to design a solution to a land management dilemma and make an evidence-based argument for their land management plan.

## *Time*

Approximately 60 minutes

## *Standards*

**5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

**MS-ESS3-3** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| • Obtaining, Evaluating, and Communicating Information<br>• Constructing Explanations and Designing Solutions | • ESS3.C Human Impacts on Earth Systems | • Systems and System Models<br>• Cause and Effect |

## *Background*

The Land Capability Classification System has been used globally to evaluate the capability land to produce crop and pasture plants and to assess how cultivation might impact land degradation. The system was developed by the U.S. Soil Conservation Service and was first published in the Soil Conservation Survey Handbook in 1939. It was created out of an attempt to farm land while maintaining land quality, taking into account specific limitations of the land such as erosion, wetness, problems in the rooting zone, and climatic limitations. The LCC system emphasized soil erosion hazards because of the irreversibility of degradation caused by soil erosion for most land.

In the Land Capability Classification (LCC) System, land is divided into eight classes. The LandPKS app automatically calculates the LCC class for each criterion using data input into the app by the user. The LCC class for the site is determined by the most limiting criteria. For example, if surface stoniness is rated a 5, and the other criteria all receive a class of lower than 5 (LCC class of 1-4), the LCC class for the site would be calculated as a 5 with surface stoniness as the limiting criterion and LCC sub-class.

To generate LCC results on the Report page in LandPKS, the user must complete data collection including Soil Texture, Slope, and Soil Limitations. Then from the Report page, you can scroll to find and select the Land Capability Classification tab. The first value is the LCC class. The number is the overall class, and the letters refer to the sub-class or most limiting criteria. Students will use the data from Lesson 2 to generate the LCC for their plot and then use this information to make land management decisions.

## *Materials*

- Phones or tablets (1 per group, minimum)
- Reports generated based on data students collected at their plot(s)

## *Preparation*

Make sure that data from Lesson 2 are available. Students will input their data (if not completed in Lesson 2) into the phones.

## *Teaching Guide*

1. **Data Entry** (20 minutes)
   Have students get into their data collection groups from Lesson 2. Pass out the phones for students to input their data. A report will be generated in LandPKS about the students' plots. The data do not need to be input in a specific order.
   - **LandCover Data Input:**
     - After opening the app and selecting the correct plot for data input, select the "Data Input" tab.
     - Under "LandCover" select the "Add New Transect Detail."
     - Pick one of the cardinal directions to start inputting data.
     - Select the "5m" tab.
     - Select the plant cover or bare ground for the five data collection points (more than one cover type can be selected).
     - Press the "Back" button. The check mark for "5m" should now be solid green. If it is not solid green, then the data was not saved.
     - Repeat for the remainder of the transect direction tabs.
     - When the five check marks (may be fewer if students were prohibited from collecting the whole 25m transect due to a barrier or time), press the back button and pass to the next transect group.

- **Soil Texture Data Input:**
    - After opening the app and selecting the correct plot for data input, select the "Data Input" tab.
    - Select the "Soil Texture" tab.
    - In the upper left corner of the screen, select the 0-1 tab (if not already selected).
    - Tap on the "Texture" box and scroll to find the texture type identified for this soil layer.
    - Below the texture box is a section for "Rock Fragment Volume." Select the rock fragment percentage that they saw in their soil layer.
    - If the data was input correctly, the arrow for this layer will turn green.
    - Pass the phone to a group that tested a different soil layer. Repeat for the other two soil layers.
    - When the texture and rock fragment value have been input for the three soil layers, all three arrows should be green.
- **Other Plot Data:**
    - After opening the app and selecting the correct plot for data input, select the "Data Input" tab.
    - Students will input data describing the landscape around their plot.
        - Land Use: Select the "Land Use" tab, and select the icon representing the type of landscape the plot is on (e.g., forest, grassland, city/village)
        - Select the Grazing tab near the top of the screen, and select the type of grazing (if any) that the plot receives from domestic or wild animals. Then select "back" until you are on the home data input screen.
        - Land Slope: Select the "Land Slope" tab and select the icon that best represents the slope of the landscape.
        - Select the Slope Shape tab near the top of the screen. The column on the left represents what the area around your plot could look like if viewed from the top or bottom of a slope. The column on the right represents what the area around your plot could look like if viewed from the middle of the slope and looked across your plot. Select the icons that most closely match the area around your plot, then select "back" until you are on the home data input screen.
        - Soil Limitations: Select the Soil Limitations tab on the home data input screen. Students will need to input data for at least three sections: vertical cracks in soil, salt on soil surface, and surface stoniness. Other data about the plots can be input if the instructor or students know them. This tab has question mark symbols for each data input category that can give more detail and information about the indicator.
        - Vertical Cracks in Soil: This refers to vertical cracks when the soil is dry that are at least 5mm wide and 25cm deep. If students have vertical cracking on their plot, they should be able to drop a pencil into the crack and have trouble retrieving it without digging into the ground.
        - Salt on Soil Surface: Students will know if they have salt on the surface of their plot if there are white, crusty patches when the surface is dry.
        - Surface Stoniness: Students will estimate what percentage of their plot area is covered with stones (>25 cm or 10 inches). The question mark for this category has a helpful graphic to help guide students.

2. **Determining and Interpreting the Land Capability Classification** (15 minutes).
    - *(Slide 24)* Once each group has entered their data, pass out the Lesson 3 worksheet. Have students fill in the LandPKS-generated LCC class and subclass at the top of their worksheet.
        - The LCC results can be found on the Report page.

- Scroll to find and select the Land Capability Classification tab. The first value is the LCC class. The number is the overall class, and the letters refer to the sub-class or most limiting criteria.
- *(Slide 25)* Land Capability Classification, LCC, is a system that groups soils based on their potential for agricultural and other uses. The LCC system was developed by the U.S. Soil Conservation Service in 1939 as an attempt to farm land while maintaining the quality of the land. The class scale ranges from 1 (very productive agricultural lands) to 8 (not productive for agricultural uses). The data collected about soil texture, slope and soil limitations help determine the LCC and describe the best current use of the plot and its degradation risk.
- The LCC sub-classes determine which soil indicators are limiting the potential of the soil, or indicate why a particular class number was assigned. For example, if surface stoniness is rated a 5, and the other criteria all receive a class of lower than 5 (LCC class of 1-4), the LCC class for the site would be calculated as a 5 with surface stoniness as the limiting criterion and LCC sub-class.

- Have students complete questions 1 and 2 on their worksheets.
- Remind students how LCC sub-classes are used and have students answer questions 3-7 on their worksheets.
  - Students will need access to their group phones or tablets so they can use the "?" symbols to figure out how the data collected is used to determine LCC classes. If no phones or tablets are available, skip question four.

3. **Using LCCs to Make Land Management Decisions** (25 minutes)
   - *(Slide 26)* Now that students have learned more about LCCs using data from their own plots, they will use this information to make land management decisions in other scenarios.
   - The teacher may (a) choose one of the one scenario for the whole class, (b) have several groups work on each scenario, or (c) allow each student or group choose one from the three scenarios. There are multiple answers for each scenario. Students will write their recommendations on the back of the worksheet and provide an evidence-based justification for their recommendations.

     **A) Scenario A:** A farmer outside of your city has just purchased three ½ acre plots of land. All of the plots have access to irrigation water. The farmer is trying to determine which staple crops can be planted on the plots. As an agricultural extension agent, it is your job to help the farmer determine which crops might be suitable for each of the three plots. After collecting data on the landscape and soil, your team has determined the Land Capability Classification for each of the three plots outlined on the map. Use these LCC subclasses and the information on the crops being considered. What recommendations would your team make to the farmer about which staple crops to plant in each plot?

     **B) Scenario B:** A small community outside of Tarangire National Park in Tanzania is putting together a village land up plan. They want to designate one area of the village for agriculture, one area for pasture for their livestock, and another as a community nature conservancy. You are part of the conservation team, and it is your job to help the village land-use-planning committee determine which areas of the village are suitable for agriculture, pasture, and conservation. After collecting data on the landscape and soil, your team has determined the Land Capability Classification (LCC) for each of the three plots outlined on the map. What recommendations would your team make to the village?

     **C) Scenario C:** The city of Las Cruces (New Mexico, United States) has an increasing population. To accommodate this larger population, they need to build more housing and infrastructure in one of three plots set aside for future city and recreational development. As a city planner, it is your job to determine if this area would be suitable for this purpose. After collecting data on the landscape and soil, your team has determined the Land Capability Classification (LCC) for each of the three plots outlined on the map. What recommendations would your team make to the city?

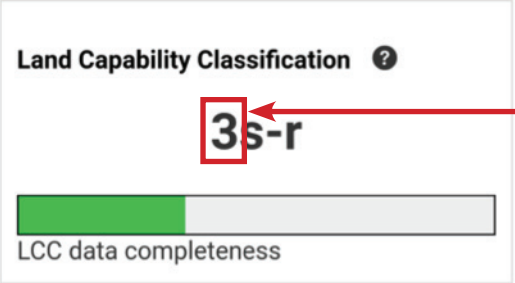
# LandPKS Lesson 3: Land Management Planning | Student Worksheet, Pg. 1

Name: _____ Plot Number: _____ Date: _____

My site's Land Capability Classification:

_____ Class *(number)*

_____ Sub-class *(letters)*




Class: This number determines the land's current best use. The highest class rating from all of the soil indicator data collected determines this number.

**Table 1. Land Capability Classification (LCC)**

This classification determines current best use of the land.

| Class | Best Use |
|---|---|
| 1 | Agriculture<br>• Few limits or restrictions on what crops you can grow |
| 2 | Agriculture<br>• Need to carefully choose what crops you grow **OR** use conservation practices |
| 3 | Agriculture<br>• Need to carefully choose what crops you grow **AND** use conservation practices |
| 4 | Agriculture or Pasture<br>• Can only grow crops adapted for your climate or region **AND** use conservation practices<br>• Obstacles like large boulders or bodies of water could prevent this plot from being good for crops |
| 5 | Pasture, Rangeland, Forestry, or Wildlife Habitat<br>• Frequent flooding and soil wetness prevent soil from being good for crops |
| 6 | Pasture, Rangeland, Forestry, or Wildlife Habitat<br>• Very poor land for agriculture |
| 7 | Recreation, Forestry, or Wildlife Habitat<br>• Not usable for agriculture **AND** very poor land for pasture |
| 8 | Infrastructure and Buildings, Recreation, or Wildlife Habitat<br>• Not usable for agriculture **AND** not usable for pasture, rangeland, or forestry |

**Using the LCC table above, answer these questions.**

1. What is the LCC class for your site? What is the "best use" of your site?

2. Does the LCC "best use" match the current use? If no, what is the current use?

My site's Land Capability Classification:

| _____ | _____ |
|---|---|
| Class *(number)* | Sub-class *(letters)* |


Sub-class: These letters determine which soil indicators are causing the class determination for the land. Addressing this indicator can raise the LCC class.

**Table 2. LCC Sub-Classes**

These letters indicate which soil indicators have determined the land's class (Table 1). Management practices to address this indicator or limitation could change the LCC class.

| Sub-Class | Best Use |
|---|---|
| e | Erosion risk - the soil is likely to be moved by wind or washed away by water |
| s-a | Soil water storage capacity - coarse soil that does not hold a lot of water for plants |
| s-d | Soil depth - the soil is too shallow |
| s-k | Salinity - the soil is too salty |
| s-l | Lime requirement - the soil needs extra nutrients to grow crops |
| s-r | Surface stoniness - too many stones on the ground |
| s-t | Surface soil texture - soil is dominated by sand, silt, or clay instead of mixed |
| w-d | Water table depth - the water table is close to the surface of the soil |
| w-f | Flooding during growing season - the amount of flooding could cause some crop damage |
| w-p | Permeability - the water moves slow through the soil which can make it water-logged |

**Using the LCC sub-classes table above, answer the following questions.**

3. What is the sub-class for your site? Describe this sub-class.

4. In the app on the phone/tablet, tap the question mark icon ( ? ) for your sub-class. Which data helped determine this sub-class?

5. Brainstorm possible actions to reduce the effect of this sub-class on your site.

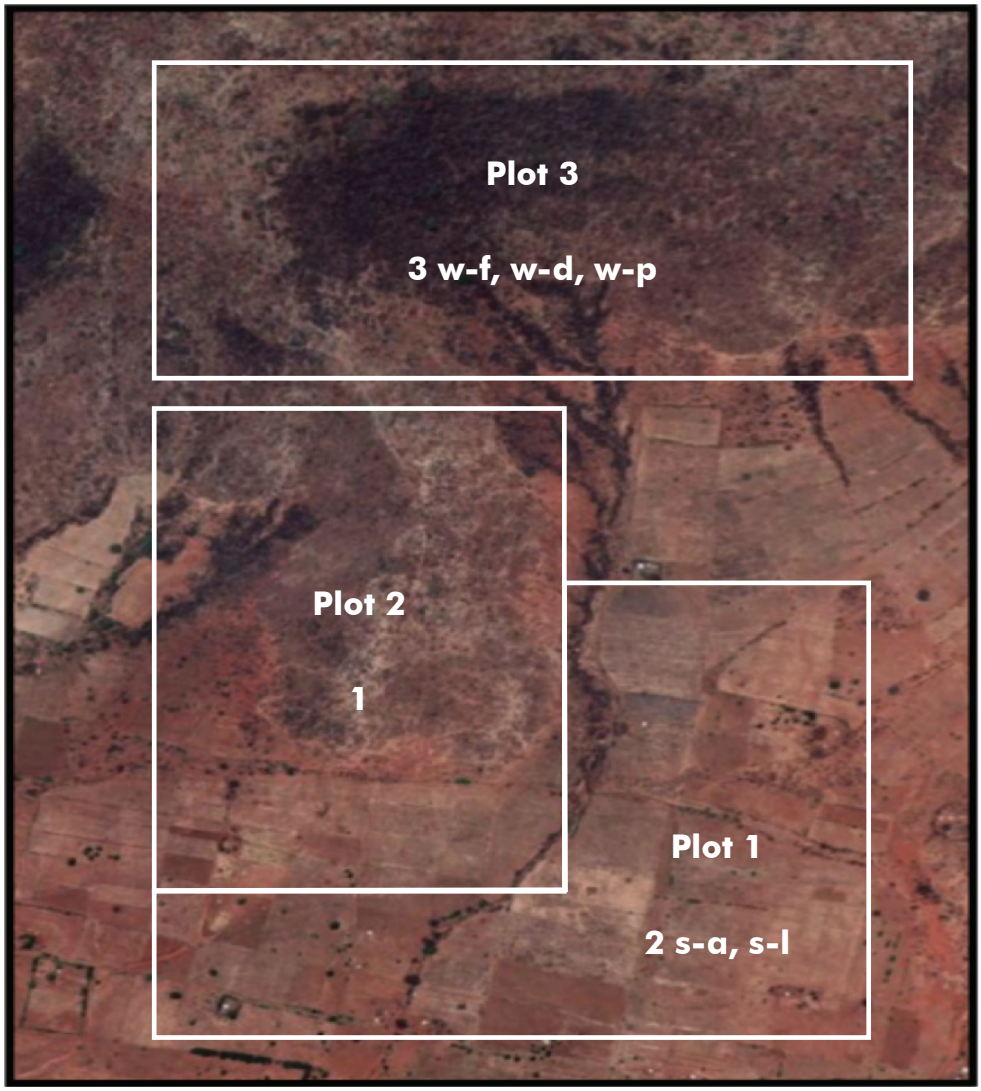
6. Do you think your site is being utilized for its best use? Why or why not?

## Scenario A

A farmer outside of your city has just purchased three ½ acre plots of land. All of the plots have access to irrigation water. The farmer is trying to determine which staple crops can be planted on their plots. As an agricultural extension agent, it is your job to help the farmer determine what crops might be suitable for each of the three plots. After collecting data on the landscape and soil, your team has determined the Land Capability Classification for each of the three plots outlined on the map. Use these LCC subclasses and the information on the crops being considered. What recommendations would your team make to the farmer about which staple crops to plant in each plot? Write a paragraph explaining your decision on the backside of this worksheet.

### Crops Being Considered

1. **Potato** – This starchy, tuberous crop is the fourth-largest food crop in the world and an integral part of much of the world's food supply. There are now more than 4,000 different varieties of potatoes. Potatoes prefer well-drained, deep, and sandy soils. Potatoes perform best in acidic soil.
2. **Maize or corn** – This crop was first domesticated in southern Mexico about 10,000 years ago. Maize is a staple food in many parts of the world, with total production globally surpassing that of wheat or rice. Maize grows best on loamy, moist, rich, well-drained soils, with higher soil water storage capacities.
3. **Rice** – This cereal grain provides more than one-fifth of the calories consumed by humans worldwide. Rice is traditionally grown on flooded fields, often called paddies. Clay soils with slow infiltration rates, or low permeability work best for rice cultivation.



**Scenario B**

A small community outside of Tarangire National Park in Tanzania (park boundary indicated by red line) is putting together a village land use plan. The want to designate one area of the village for agriculture, one area for pasture for their livestock, and another as a community nature conservancy. You are part of the conservation team, and it is your job to help the village land-use-planning committee determine which areas of the village are suitable for agriculture, pasture, and conservation. After collecting data on the landscape and soil, your team has determined the Land Capability Classification (LCC) for each of the three plots outlined on the map. What recommendations would your team make to the village? Write a paragraph explaining your decision on the back of this worksheet.

**Scenario C**

The city of Las Cruces (New Mexico, United States) has an increasing population. To accommodate this larger population, they need to build more housing and infrastructure in one of three plots set aside for future city and recreational development. As a city planner, it is your job to determine if this area would be suitable for this purpose of housing. After collecting data on the landscape and soil, your team has determined the Land Capability Classification (LCC) for each of the three plots outlined on the map. What recommendations would your team make to the city? Write a paragraph explaining your decision on the back of this worksheet.