MDT Training Report

MDT Training #1 for EBRD Project (September 2015)

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Introduction

Within Mongolia, companies whose business practices impact the land and alter the natural state of the environment are required by law to offset those impacts. Companies may work directly with Ministry of Environment to create an extensive and detailed offset plan or they can follow Section 3.3.6 of the Mongolian Offset Regulation (MOR) to fulfil offset requirements through compensation. Following this section, companies calculate required offset measures in three main steps: 1) Identify the area that is likely to be affected by the proposed project (i.e. map the development footprint and its direct supporting infrastructures, delineate an impact area, and determine the magnitude of these impacts); 2) Use this impact area to calculate the total offset units necessary to meet the offset regulation; and 3) Calculate total yearly offset compensation value. For each step, the MOR defines methods for calculating and fulfilling these requirements. In order to follow these steps, it is however necessary to be well versed in using GIS and fully understand all data used in the analysis. Without this knowledge, the regulation can be difficult to implement leading to inconsistencies in those trying to follow the law.

To meet this implementation gap, The Nature Conservancy (TNC) in partnership with the Mongolia Ministry of Environment and Green Development (MEGD) produced a series of documents and GIS tools to provide companies with the ability to easily and efficiently determine their offset compensation requirements. Overall this effort will produce the Mitigation Design Tool (MDT) which will be available as a desktop, ArcGIS application (MDT-Desktop) and as an open-source, internet application (MDT-Web). The MDT-Desktop is a toolbox with a collection of customized tools supporting the MOR. It has four main toolsets; Land Disturbance and Impact Tools, Offset Tools, Supplementary Avoidance Tools, and Update Tools. The *Land Disturbance and Impact Tools* assist users in following standards set for creating LDs such as projection and attribution and then allow for using these LDs to create a project impact dataset. The *Offset Tools* use the project impact dataset to derive an offset cost report and identify potential offset locations. The *Supplementary Avoidance Tools* allow users to relatively compare potential offset costs for either leases and or planned land disturbances. By providing these tools, users can look at ways to potentially limit their offset costs while also avoiding important landscapes and habitat within Mongolia. Finally the *Update Tools* help users stay current with the application database without having to reinstall the MDT application.

This endeavour was part of a larger effort of building capacity within MEGD to support landscape-level conservation in the southern Gobi and was directly financed by the European Bank for Reconstruction and Development (EBRD) Shareholders Special Funds. Specifically TNC assisted MEGD and other stakeholders in the identification, review, assessment, implementation, and monitoring of mitigation and other conservation measures. Four main tasks were identified within this project: 1) conduct an analysis of habitat connectivity of Asiatic Wild Ass (Equus hemionus, or khulan) in the Eastern Gobi Desert region; 2) create the mitigation design tool (MDT); 3) assess alternatives and logistical constraints of regional traffic; and 4) provide training for a) performing habitat connectivity analyses, b) using MDT, and c) assessing regional soil conditions in the mineralized zones of the Gobi Desert.

This report focus on the training provided during the week of September 7th, 2015 specific to understanding and using the MDT-Desktop. Three different groups of people attended the trainings (see Attendees section of this report): managers from MEGD, government employees from federal and local agencies responsible for implementation of the offset regulation, and private mining and environmental companies required to comply with the offset regulation. This required a managers workshop lasting two hours on Sept 8th and one-day classroom trainings occurring on two separate days for government employees (Sept. 10th) and private employees (Sept. 11th). Although not scheduled within the EBRD project timeline to occur until March 2016, these trainings were moved up considerably

in the schedule since there is an immediate need to assist those both implementing and complying with the MOR. Additionally there was need to gain feedback from those using the tool to make sure it was providing the necessary items to support the MOR. Feedback on the tool is currently ongoing and will be incorporated into the next version of the tool due to be released by the end of 2015.

Objective of Trainings

We had several objectives associated with the MDT trainings. For the manager's workshop, our goal was to provide these folks with a broad understanding of how the tool works and keep them up-to-date of the development of the tool. Additionally we wanted to make sure they understood some of the issues which need to be addressed by the federal government to insure the success of fully implementing the MOR. We accomplished this though a presentation and demonstration of the MDT-Desktop which was followed by a lengthy discussion on needs surrounding the implementation of MOR using the tool.

For the one-day trainings, we had one overall objective of providing users with the knowledge and expertise to be able to use the MDT-Desktop. Additionally we wanted each participant to fully understand all the data and procedures behind the tool so they didn't view the tool as a "black box". We accomplished this by providing a series of six lectures and four exercises. All of the exercise required students to either use MDT-Desktop tool directly within ArcGIS or perform ArcGIS procedures on spatial data which was then related back to how this analysis was incorporated within the tool.

Curriculum/Skills Taught

Unit 1 – MDT Background
- Lecture – Background on MDT
- Exercise – Exploring MDT Application Data and Running MDT Offset Cost Report

This unit gave students a complete background on why the MDT was created, how it was created, how to use the tool and all the data supporting the tool. Exercise required them to explore all data used by the tool and run the tool to produce an offset cost report for pretend mine plan in the Gobi region.

Unit 2 – Disturbance and Impact Area Details
- Lectures – Details on creating land disturbance data and calculating project impact area according to the Mongolia Offset Regulation
- Exercises – Assigning disturbance values to land disturbance dataset and creating project impact area.

This unit went into detail on how to create land disturbance data and requirements behind spatial data representing disturbances. It also went into detail on how to derive an impact area based disturbance data. This required students to understand how distant decay functions are used within the tool and relate to what has been documented by the regulation. Exercises required users to edit and create disturbances based on a scanned, mine site plan and then calculate impact areas for two of the disturbance features manually. The students then used tools within the MDT-Desktop toolbox to create and check disturbance data and calculate an impact area. This helped them understand how efficiently the tool does this procedure in comparison to the manual steps.

Unit 3 – Offset Calculation Details

- Lectures – Using project impact area to derive Mongolian Offset Regulation, Offset Cost Report and identifying potential offset sites.
- Exercise – Calculating offset cost report and identifying potential offset sites.

This unit focused on both locating potential offset locations and calculating the offset costs. To understand how to derive offset costs, it was necessary to first describe in detail how the locational offset factors (i.e. Habitat Type, Ecosystem Occurrence, Landscape Condition, and Landscape Position) were created. Since each of these datasets is directly tied back to the Ecoregional Assessments, data produced by this effort was also discussed. In addition to knowing how these factors are produced it was also important to describe the offset ratios used in calculating costs and how the overall cost is derived from intersecting an impact area with all locational offset factors and a temporal factor. For an understanding of selecting potential offset locations, students learned how the tool uses ecosystem summaries for protected areas and portfolio sites and compares these regions with the ecosystems impacted in order to derive potential offset sites. Again in the exercises the users did these steps manually and then used to the tool to see the efficiencies in using the tool.

Unit 4 – Supplementary Avoidance Tools & MDT Discussion

- Lecture – Supplementary Avoidance Tools
- MDT Discussion
- Exercise (optional) – Running MDT with modified land disturbance data due to avoidance measures

This last unit described how the avoidance tools within the toolbox work and how these tools can be used to quickly look at ways at decreasing offset costs and avoid restricted development areas (i.e. protected areas). Additionally, we scheduled time for an open discussion allowing for students to ask any questions regarding the MDT or MOR. The optional exercise had students use the avoidance tools to find ways to modify potential land disturbances in order to decrease offset costs.

Course Materials

All students received a USB drive with documents, data, tools, exercises and presentations. Presentations and exercises were provided in both English and Mongolian. This allowed for students to share all information with others and have the ability to perform the exercises at later dates. The USB had four main directories named Documents, Exercises, MDT_Ver1, and Presentations. The Documents directory contained all documents currently created for this effort (i.e. GIS Protocols and Procedures, MDT-Desktop Application Plan, and MDT-Web Application Plan). The Exercises directory had a series of MXD files associated with each exercises, data used in the exercise and all the solutions to the exercises. The exercises without solutions and translated were handed out as paper copies to each of the students to make it easier for them to do the training. The MDT_Ver1 directory was the folder containing the MDT-Desktop which was used throughout the exercises. This directory also contained help documentation for the tool both in English and Mongolian. The Presentations directory had all the presentations used for the lectures.

Class Evaluations

All those attending the one-day trainings were asked a series of questions at the end of the training to gain feedback and evaluate our performance.

Questions Asked

1) What was most important with the training?
2) What was least important with the training?
3) What would you remove from the training?
4) Were the exercises helpful and why?
5) Are there items you would change with the exercises?
6) Do you feel you can now successfully calculate a yearly offset cost as defined by the Mongolia Offset Regulation?
7) If you answered no to question 6, please explain why?
8) From 1 (lowest) to 10 (highest) please rank the value of the training?

Responses

Training name: MDT training lab
Number of participants: 27;
Number of participants who gave feedback: 24 ;

1. **Most important part of the training**
   - Some terms need to be changed to official/professional terms.
   - Analyzing.
   - Practice.
   - Animal habitat and defining their migration route. /2/
   - All information about distance decay function
   - Defining offset area
   - Identifying offset site
   - Calculate offset cost
   - Identifying project impact areas
   - ArcGIS, tools, user guide
   - It was helpful that all the training materials were given out on a flash drive.
   - guidelines
   - Base map understanding, assessment
   - Understanding the relation between all that we learned
   - Study curriculum, program designed to give individual practice
   - Connectivity model
   - To work on a tool that's ready-to-use
   - It is critical to have Offset cost report is done automatically
   - Data and materials were excellent that made it easy to work on
   - Exercises and hands-on experience with the tool.
   - new info

- EIA requires offset. Therefore, having a tool that does offset cost calculation, identifies impact area and offset site makes it very easy. Also, I liked how you organized a training to introduce the tool and got feedbacks.

2. **Most irrelevant part**
   - 3 /not sure/
   - 21 /nothing/
3. **What do you like to exclude from the training**
   - 2 /don't know/
   - 22 /nothing/
4. **Were the exercises important to you?**
     - It is important to know about it.
     - Exercises were very important, easy to understand.
     - Important, because we are required to use it at work
     - Very important. Translations of each step were very helpful. Renewed my previous understanding.
     - Lectures were important to understand the tool.
     - It was helpful that we got to do it step by step.
     - It is important that the tool can identify portfolio sites and PAs for developing land use planning. I understood that the tool can be used in our planning work.
     - Offset calculations now make sense.

5. **What you change about the training**
   - Have the exercises translate by professional teachers, have practical terms in translations
   - Translated materials were like my teacher.
   - Linear and area layers need to be translated.
   - Need more time to go through the exercise solutions with the teacher
   - Some ex steps were hard to understand and some questions didn't make sense.
   - Improve translation or provide English version.
   - Add more theory for more understanding
6. **Can you calculate offset cost on your own according to MOR.**
   - 6 /no/
   - 7 /yes/
   - 4 /maybe/
   - 4 /will try/
7. **If you answered no to previous question, explain why.**
   - Can do it after attending one more training and verifying my understanding
   - More info, data and practice needed.
   - It was my first (their province) hearing about it, but now I have an understanding
   - Didn't have enough time
   - Not enough time

o   After doing some practice

8. **Rate the training**

Rating – Number of students assigning rating

1 - 0; 2 - 0; 3 - 0; 4 - 0; 5 - 0; 6 - 0; 7 - 1; 8 - 7; 9 - 9; 10 - 6

Location of Training

Manager's workshop: MGED conference room
One-day trainings: National University of Mongolia, GIS Lab – Dr. Bolorchuluun

Attendees

Manager's Workshop for MDT and Connectivity

No	Name	Position	Organization	Tel	E mail
1.	Tsogtsaikhan.P	Diractor of environmental assesment and audition department	MEGDT	99075559	tsojopurev@gmail.com
2.	Temuulen.D	Officer	MEGDT	99057170	temulengees@yahoo.com
3.	Oyunbileg.Kh	Officer	MEGDT	99224979	oyunbileg@mne.gov.mn
4.	Bayartsetseg.S	Chief officer	MEGDT	95952848	bayaraabayars@yahoo.com
5.	Nandin-Erdene.Kh	Officer	MEGDT	88116250	
6.	Gunbileg.L	Officer	MEGDT	99952966	idinaswet@yahoo.com
7.	Bayarkhuu.S	Chief officer	MEGDT	99049896	bayarkhuu@mne.gov.mn
8.	Jargalsikhan.L	Chief officer	MEGDT	88057170	mongoliamgo@gmail.com
9.	Erdenebayasgalan.G	Chief officer	MEGDT	88101010	erdenebayasgalan.ganj@yahoo.de
10.	Batjargal.Ts	Officer	MEGDT	91195490	tsbatjargal@yahoo.com
11.	Chimeg.J	Programme Analyst	UNDP	327585-127	chimeg.junai@undp.org
12.	Munkhzul.Ts	Officer	Academy of Science, Biological institute	99868116, 86061276	tsmunkhzul@yahoo.com
13.	Otgontugs.M	GIS officer	MEGDT	99190844	otgontugs_ngic@yahoo.com

Student List - MDT training for government officials

No	Name	Position	Organization	Tel	E mail

1	Erdenebayasgalan.G	Chief officer	MEGDT	88101010	erdenebayasgalan.ganj@yahoo.de
2	Otgontugs.M	GIS officer	MEGDT	99190844	otgontugs_ngic@yahoo.com
3	Sanjmyatav.D	Officer	Oyu Tolgoi LLC	99014170	sanjmyatavD@ot.mn
4	Bolorchuluun.Ch	GIS lecturer	MNU	89143579	bolorchuluun@gmail.com
5	Tsogtsaikhan.B	GIS officer	TNC	88965060	tbattsengel@tnc.org
6	Naranzul.B	Project officer	TNC	99124670	naranzul.bazarsukh@tnc.org
7	Binderya.O	Project officer	TNC	99044979	binderya.oyunbaatar@tnc.org
8	Purevbaatar.G	GIS officer	TNC	89500302	puuu.jeee@yahoo.com
9	Batdorj.B	Officer	TNC	97185888	batdorj72@yahoo.com
10	Orgilmaa.B	Officer for underground resource and reclamation	Umnugobi province	99074877	orgio_78@yahoo.com
11	Sugirsuren.E	Officer	Umnugobi province	86985628	
12	Soyolmaa.T	Ranger of Tsogttsetsii soum	Umnugobi province	88555000	tsoyoloo@yahoo.com
13	Oyungerel.N	Officer	Dornogobi province	99043225	Gerel_64@yahoo.com
14	Nyamkhuu.Sh	Officer	Sukhbaatar province	96899366	sh_nyamhuu@yahoo.com
15	Tsetsegdelger.U	Officer	Sukhbaatar province	93019387	deegii_0610@yahoo.com
16	Bilguunzaya.B	Officer	Dornod province	99571467	batboldbilguunzaya@gmail.com
17	Munkhnaran.E	Officer	Dornod province	89130300	monkhnaran_e@yahoo.com
18	Munkh-Erdene.G	Officer for underground resource and NP areas	Khentii province	96480704	muugii_best@yahoo.com
19	Bilegsaikhan.Ts	Officer for cadastre and geodesy	Khentii province	91992817, 98992817	bilegee_0628@yahoo.com
20	Nansalmaa.A	Officer for wildlife movement	Khovd province	99439314	nansaa_ok21@yahoo.com
21	Lkhamkhuu.B	Head of environment and tourism department	Khovd province	99008303	oidovarihuu@yahoo.com
22	Davkharbayar.D	Ranger	Mongol Altai NP	95423957	ddavharbayar@yahoo.com
23	Gankhuyag.P	Director/ bird researcher	Mongolian Bird Conservation Center	88077576	pgankhuyag@gmail.com

24	Buuveibaatar	Biologist	WCS	99792424	buuveibaatar@wcs.org
25	Tungalag	Project officer	SPAN project		
26	Munkhbaatar.D	Biologist	Wild Sheep Center	88476580	
27	Gantig	Officer of cadastral department	ALAGC		

Student List - MDT Training for mining and environmental companies

	Name	Position	Organization	Tel	E mail
1	Oyuntsetseg.L	Officer	UUCHO LLC	99796143	env.ksp@mno.mn
2	Enkhtuul.Ch	Environmental manager	Hunnu Resource LLC	99008077	enkhtuul.ch@hunnucoal.com
3	Otgonbaatar.L	Technological officer	Mon-Atom LLC	88915037	otgmbatr90@yahoo.com
4	Narangerel.S	Officer	Boroo Gold LLC	99820788	narangerel.S@centerragold.mn
5	Nurbolat.T	Environmental manager	Erdenes Tavan Tolgoi shareholding company	89095503	nurbolat.t@erdenestt.mn
6	Iderjavkhlan.S	GIS expert	Energy Resource LLC	88000455	iderjavkhlan.s@mmc.mn
7	Samdanjigmed.T	Environmental officer	Bayan-Airag LLC	99077134	samdanjigmed.t@bayanairag.com
8	Erdenebat	Hydrogeologist	MAK	89924434	jamts_0608@yahoo.com
9	Buyan-Ulzii	Officer	Numan Altai LLC	88262216	grewboyka@yahoo.com
10	Maasuren.B	Officer	Sun lotus LLC	89836759	maasuren_0627@yahoo.com
11	Batbayar	Officer	Dachin Tamsag LLC	99144518	
12	Altanzul	Officer	Usukh zoos LLC	99887385	altanzul.uz@gmail.com
13	Chimegbayar	GIS Officer	Asian ecology LLC	99811720	chimegbayar90@gmail.com
14	Uranchimeg.E	Officer	Nature Friendly LLC	89280109	uranchimeg@naturefriendly.mn
15	Munkh-Erdene.B	Officer	Green Grands LLC	99466607	ma.moogii@gmail.com
16	Bayarmagnai	Officer	Petro Matad LLC	99008407	magnai@gmail.com
17	Narangarav	Environmental manager	EHLM LLC	99937188	solntse0330@yahoo.com

Recommendations and Future Training

Training with regards to the MDT will continue to be important as the MOR is implemented. By the end of this project, the training will also include the MDT-Web application and will need to be extended to two full days. TNC will develop these additional training materials and provide this two-day training in March. After the EBRD project is completed however it will be important for MEGD to identify someone responsible to continue to educate both those inside and outside of MEGD on the value of using this tool. TNC will provide all materials to MEGD and will give them full rights to update, modify and adapt any of these training materials in the future. Additionally all training materials will be on-line allowing for users to learn how to apply the MDT on their own.

Appendix A – Attached Exercises with Answers

Exercise #1
Exercise 1a – Setup of MDT and data exploration of application database.

☐ Place external drive into USB port and make sure your computer can read the external drive.

☐ Open a new session of ArcMap use the Customize menu and select Extensions. Make sure there is a check in front of Spatial Analyst, if not check this box.

☐ Use the Catalog window to create a new folder connection to the MDT_Training folder on your external drive.

☐ Expand the MDT_Ver1 folder, how many toolboxes are within this directory? 2

☐ Open the ArcToolbox window (e.g. click on Toolbox button). Within this window, right click on the top item named ArcToolbox and select Add Toolbox. Select the folder you mapped above and open the MDT_Ver1 folder. Select the MDT Toolbox (i.e. MDT.tbx) and click on the Open button.

☐ This should add the toolbox MDT to your list of toolboxes. Now again right click on the top item named ArcToolbox and select Save Settings>To Default. This adds the toolbox to future ArcMap sessions.

☐ Expand the MDT toolbox. How many toolsets are within this toolbox? 4

☐ Expand the Update Tools toolset and double click on the Check for Application Database Updates tool. Place a check in front of Update database, if needed. Click the OK button.   Is your MDT database current? yes

☐ Expand all the other toolsets within the MDT toolbox. Which toolset has the most tools? Land Disturbance and Impact Tools

☐ Close the ArcToolbox window

☐ Go back to the Catalog window and expand the MDT_Ver1/scripts/Data folder under your connected MDT_Training folder. There should be five folders and a DatLog.txt file found in this directory.   This folder contains all of the application data used by the MDT-Desktop tools.

☐ Expand the Data/Compare folder and add the NoGoZones.shp to ArcMap.
   o By looking at these data and their attributes, guess what these data represent? national and local special protected areas

   o What is the largest area having any type of protection? Bayanxongor

- How many local special protected areas are within the Gobi? 291

- From the lecture, how is this dataset used in the application? Helps identify potential development restrictions

☐ Expand the Data/Cost folder and add all four raster datasets to ArcMap.
- What are the values for all four of these datasets? 1,2,3

- Which dataset has the largest resolution (i.e. smallest cell size)? Ecosystem Type – 78.25

- From the lecture, how are these four datasets used in the application? Used for calculating offset costs

☐ Expand the Data/Impact folder and add the area_disturbances.dbf to ArcMap. Open the table within ArcMap.
- How many records are listed? 18

- Which type value has the largest Dist value? City

- Which type value has the value "Abrupt " within the DecayFnct field? Parking-Paved

- From the lecture, how is this table used in the application? Used to calculate project impact area

☐ Expand the Data/Location folder. There are only two folders which contain data (i.e. Common and Gobi). The remaining folders are placeholders for future versions of the application as MDT support is provide for these regions.

☐ Expand the Data/Location/Common folder and add all data having either an ".img" (i.e. raster dataset in the ERDAS IMAGINE format) or an ".shp" (i.e. ESRI shapefile format) extensions to ArcMap
- What is the extent of all of these datasets? Mongolia-wide

- Turn all layers visibility off except for Soums_Poly and Soum_Bnd.img. When looking at the attributes of these two layers, what attribute of Soums_Poly equals the values found in the Soum_Bnd.img dataset? ID

☐ Expand the Data/Location/Gobi folder and add all these data to ArcMap. Make the VegEcoSyst.img layer the only visible layer and open its attribute table.

- Which TES_NAME (i.e. ecosystem type) category is represented most in the Gobi? Semi desert

- Which TES_NAME (i.e. ecosystem type) category is represented the least in the Gobi? ephemeral lakes

- From the lecture, what effort produced this dataset? TNC Gobi ERA

☐ Make the PortfolioWithAtts layer the only visible layer and open its attribute table.
  - What is the AREANAME of the largest feature found within this dataset? Goviin ix

  - Is the largest feature a protected area? Yes

  - For this largest feature, what is the value of the attribute HA_11? 226231.22

  - Open the ES_Classes table, using this table identify the ecosystem type associated with HA_11 field found in the PortfolioWithAtts layer? Barren

  - Knowing this naming methodology within PortfolioWithAtts attribute table (e.g. HA_12 lists the hectares of the ecosystem type "extreme arid" and Prop_12 lists the proportion of area with the ecosystem type "extreme arid"), use this attribute table to answer the following:
    - Which AREANAME has the largest amount of Ephemeral Lakes? Zagiin Us urgutgul

    - Which AREANAME has the largest proportion of Riparian Dense Vegetation? Bulgan gol

☐ Make the SoumPortfolioWithAttts layer the only visible layer and open its attribute table
  - How is this layer different than the PortfolioWithAtts layer? They are dived by Soum boundaries

  - Knowing the field names have a similar naming convention (e.g. HA_12 lists the hectares of the ecosystem type "extreme arid") with the Soum name now being within the Name field, identify which portfolio site (i.e. AREANAME) within which Soum has the largest amount of Ephemeral Lakes? Zagiin Us urgutgul in the Mandax soum

☐ From the lecture, how are all data associated with the location folder used by the MDT? Helps identify potential offset sites

☐ Close ArcMap without saving.

Exercise 1b – Quick run through in creating an offset cost report.

☐ Open EX_1b.mxd within the MDT_Training/Exercises folder

☐ Open the Oakleaf Fake Mine – Linear Land Disturbance attribute table. Write down how many features are found in this layer. 4 (features don't always match the legend for example there are two different improved dirt roads within this layer)

☐ Open the Oakleaf Fake Mine – Area Land Disturbance attribute table. Write down how many features are found in this layer. 5

☐ Using the Catalog window, create a new folder with the name MDT_Output on a local drive having read/write permissions (e.g. C:\MDT_Output). You will use this folder for all the data and files generated with the MDT tool. For ease in accessing this folder, you may want to also use the Connect to Folder tool in the Catalog window and set this folder as an ArcGIS connected folder.

☐ Open the ArcToolbox window and select the MDT toolbox. Under the Land Disturbances and Impact Tools, double-click on Step 2 – Calculate Project Impact Area.

☐ Select the Oakleaf Fake Mine –Linear Land Disturbances for the Linear Features and the LD_Code field for the Field Name. Do the same for Area Features using the Oakleaf Fake Mine – Area Land Disturbances layer for the input. Finally set the Output to the name Oak_Project_Impact.img and place it within the new folder you just created named MDT_Output. Your dialog should look similar to the one below.

Note: For all remaining exercises, dialogs will show C:\MDT_Output which refers to your MDT_Output folder regardless of where this folder was created. This will also be referenced just as MDT_Output folder in the text.
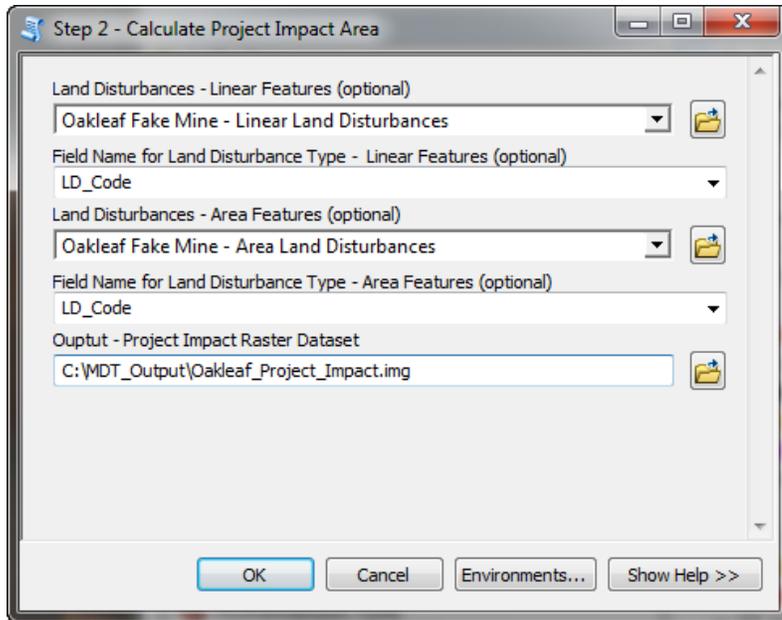
- ☐ Click the Ok button to run
- ☐ Examine the output dialog as this tool runs. It will inform you as each LD feature is used in creating a Project Impact Area

- ☐ If you drink coffee or tea, this would be a good time to go and get it ☺

- ☐ Once the application is finished write down how long it took to calculate the project impact area for these disturbances.   Will vary but ran for 10 minutes on my computer.

- ☐ Make the Oakleaf_Project_Impact.img the only visible layer and open its attribute table. Which impact category has the most area associated with it?   10-Low

- ☐ Within the MDT Toolbox under the Offset Tools select the Step 3 – Calculate Offset Cost Report tool and set Project Name to Oakleaf Fake Mine, select the Oakleaf_Project_Impact.img layer for the Project Impact Area Raster, select Medium (5-20 years) for Project Duration, and output the HTML File to your MDT_Output folder naming it Oakleaf.html. It should match the dialog below.

Step 3 - Calculate Offset Cost Report

Project Name
Oakleaf Fake Mine

Project Impact Area Raster
Oakleaf_Project_Impact.img

Project Duration
Medium (5 - 20 years)

HTML File Output
C:\MDT_Output\Oakleaf.html

OK   Cancel   Environments...   Show Help >>
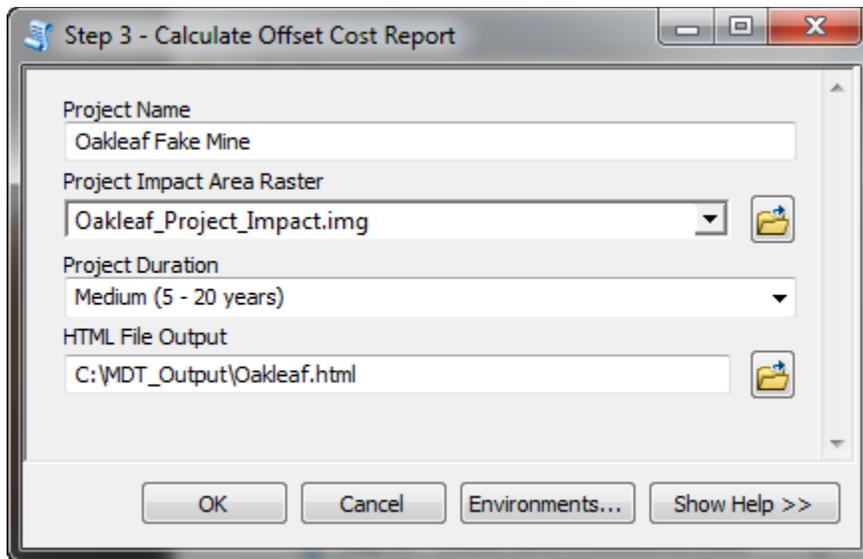
☐ Click the OK button

☐ Examine the output dialog as the tool runs

☐ When the report opens, scroll through it and answer these questions:

      ○ What is the total offset cost per year for this project? $165,619

      ○ What are the total hectares of the area impacted? 7,711.14 ha

      ○ What is the percent of impacts found within Xovsgol Soum? 0.38%

      ○ What is the ecosystem which is most impacted within Ulaanbadrax Soum? Desert steppe

☐ Close your internet browser with the html report and close ArcMap without saving.

Exercise #2

Exercise 2a – Creating and Editing Land Disturbance Data.

☐ Open EX_2a.mxd within the MDT_Training/Exercises folder.

☐ You will see three layers; Land Disturbances-Linear, Land Disturbances-Area and Fake Mine Plan. The Fake Mine Plan is a plan which was never developed however it has been geo-referenced to simulate a potential mining plan within the Gobi region.

☐ Using the measure tool, what is the approximate area in KM^2 of this planned development? Answers will vary but roughly 5 km^2

☐ If you were going to digitize the land disturbances of this site plan with ArcMap, the first step would be to create land disturbances data using the Step1a – Create Land Disturbance Data tool. Open the ArcToolbox window and select the MDT toolbox and open this tool.

☐ Select your MDT_Output folder for a project Folder Location and keep the default setting for the rest of the tool. NOTE: If you set your MDT_Output folder as a Connection Folder, you will need access this folder using the Connection Folder containing this directory (e.g. C:\). This is a bug in ArcGIS since it does not recognize Connection Folders as acceptable workspaces. Your dialog should look similar to the dialog below.
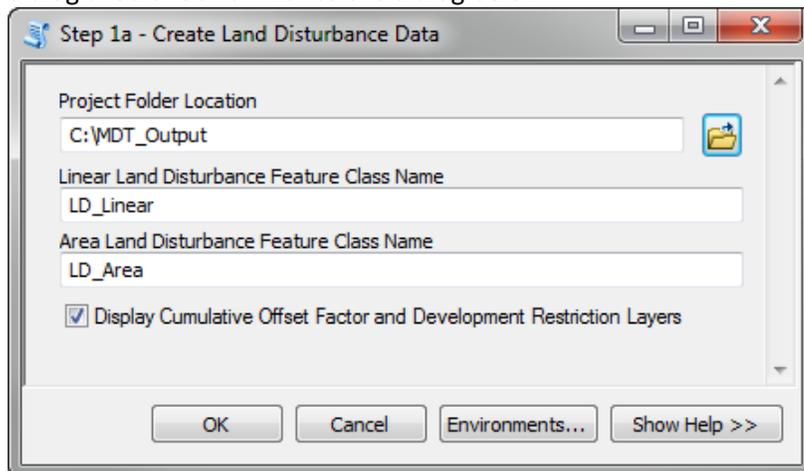
☐ Click the OK button.

☐ How many layers are added to ArcMap? 4

☐ Make the Development Restrictions layer and the Fake Mine Plan the only visible layers. Are there any mapped development restrictions in this area? No

☐ The Cumulative Offset Factors layer will be discussed later however it gives users the ability to see estimate values of offset costs while creating your land disturbance layers so the user when presented with options can choose low offset cost areas to develop. Place this layer below the

Fake Mine Plan layer. Which land disturbance appears to have the potential for the highest offset cost? Overburden Piles in the south part of the planned development

☐ Remove both the Development Restrictions and Cumulative Offset Factors layers from ArcMap.

☐ Using the Catalog window, navigate to the MDT_Output folder, right click on mdt_land_disturbances.gdb and select the Properties menu. Click on the Domains tab in the Database Properties window. How many domains are associated with this file geodatabase? 2

☐ How many coded values are available for the MDT_LD_Area_Domain? 18

☐ Close the Database Properties window and display the layer properties associated with the LD_Area layer by right clicking on the layer name and selecting the Properties menu. Click on the Fields tab within the Properties window and select the LD_Code field by clicking on its name in the list of field names. What is the name of the Coded value domain associated with this field? MDT_LD_Area_Domain

☐ What field will therefor contain your land disturbance codes associated with the MDT? LD_Code

☐ Now click on the Source tab within the Properties window. What projection has been assigned to these data? UTM Zone 48 North using the WGS 1984 datum

☐ Remove the LD_Linear and LD_Area layers. Normally you would use these datasets to begin digitizing land disturbances however they have already been digitized for you and are named Land Disturbances – Linear and Land Disturbances – Area.

☐ Now to check these datasets which have already been digitized, we will run the Step 1b – Check Land Disturbance Data tool. Open this tool within the MDT toolbox. Input the appropriate values within this dialog. It should look exactly like the dialog below.
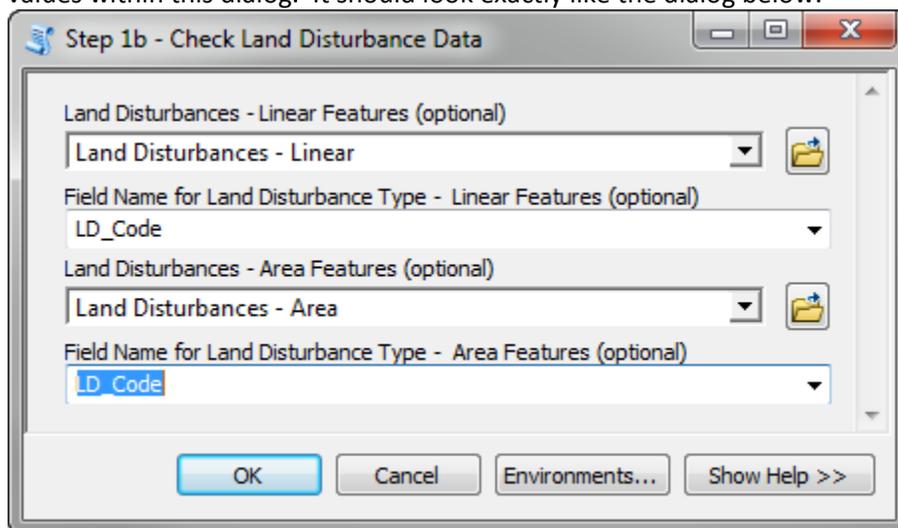
☐ How many errors were found within Land Disturbances – Linear layer? 3

☐ How many errors were found within Land Disturbances – Area layer? 7

☐ We will now fix these errors by attributing features which caused the errors. Make the Land Disturbances – Linear layer the only visible layer.

☐ Start a new edit session. This can be done by clicking on the Editor button [icon] which displays the Editor Toolbar. Then by clicking on the Editor menu and selecting the Start Editing menu, you will start an edit session.

☐ Add the Attributes editing window by clicking on the Attributes button [icon] on the Editor Toolbar.

☐ Now use the Editor Selection tool [icon] and select the main road running on the West and North side of the planned development. Within the LD_Code field click on the dropdown menu and select Roads-Paved.

☐ Assume the other linear features are Roads – Improved Dirt and code them following the same procedure as above.

☐ Save your edits by clicking on the Editor menu and selecting Save Edits. Clear all select features.

☐ Now make visible the Land Disturbances – Area and Fake Mine Plan layers. Follow the same procedures but this time select polygons and assign the appropriate land disturbance codes to these area features. If the Fake Mine Plan map is difficult to read, use the following guide:
        Light blue – mine pit
        Light brown – overburden piles
        Dark green – growth media piles
        Blue – heap leach pads
        Dark brown – processing facilities except for the one nearest the entrance which is an office facility

☐ Save your edits, clear all selected features, and stop your edit session by clicking on the Editor menu and selecting Stop Editing
.

☐ Now display each layer setting the symbology of each to use LD_Code field with a Unique Values categorization. Look at the screen capture below, your colors may be different but your ArcMap display should look similar with the layers overlapping all the land disturbances found in the georeferenced site plan.   NOTE: Due to the Domain Codes associated with the LD_Code attributes, ArcMap automatically adds a legend with all possible domain codes. You will need to remove from the symbology those disturbances which are not part of this planned development.
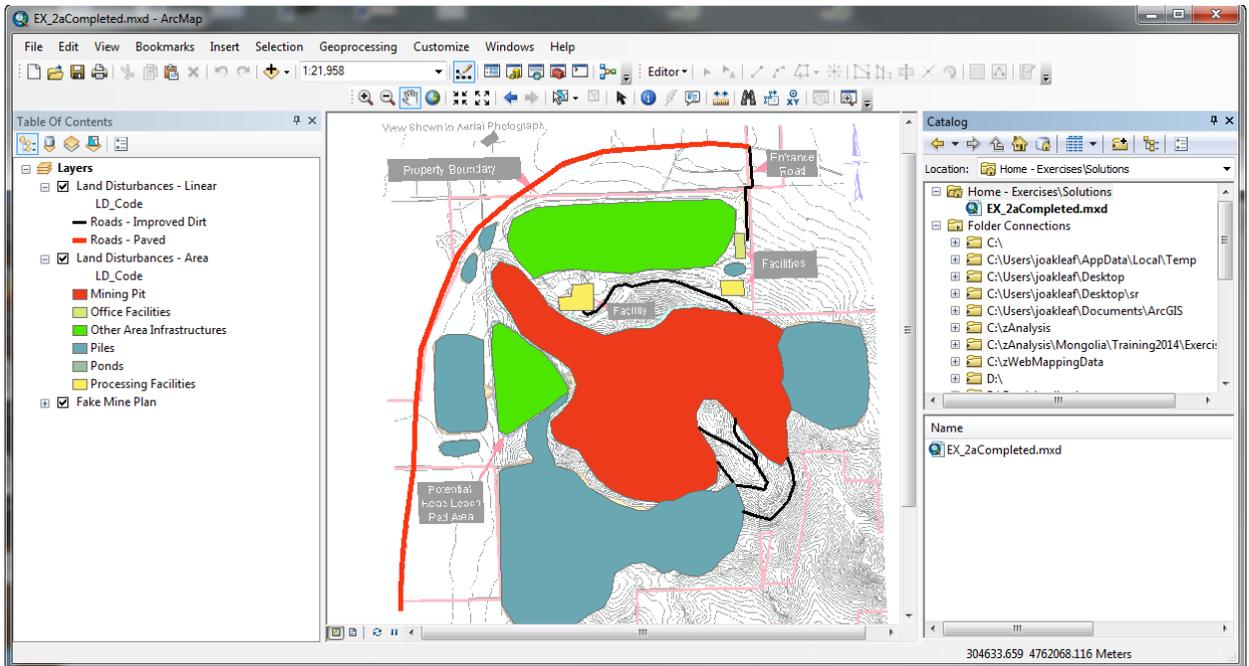
☐ If you missed one start a new edit session and attribute the feature you missed and save your edits.

☐ Now to double check our work, we will run the Step 1b – Check Land Disturbance Data tool. Open this tool within the MDT toolbox. Input the appropriate values within this dialog. It should look exactly like the dialog below.
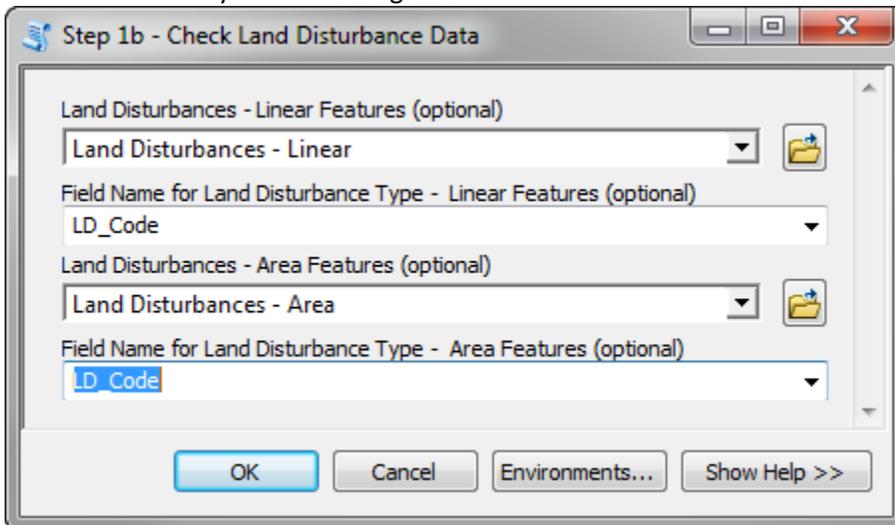
☐ You should have received a message saying: "There were no errors or warnings with your data. These data can be run successfully with the Step 2 – Calculate Project Impact tool."

☐ Close ArcMap without saving.

Exercise 2b – Creating Project Impact Area

☐ Open EX_2b.mxd within the MDT_Training/Exercises folder.

☐ You will see the same area we just mapped however due to the entire site being fenced and only two land disturbances occurring outside of the fence (i.e. paved road and improved dirt entrance road), only the fenced area and those land disturbances outside of the fenced area need to be used for the project impact calculations.

☐ Additionally two tables have been added to ArcMap; area_disturbances and linear_disturbances. Examine these tables. From the lecture, describe what these tables are used for:

Assigned impact tables for land disturbances.

☐ Open the area_disturbances table, find the Type field and identify the record with the value Fenced Area. For Fenced Area, write down the DecayFnct, Dist, and Weight.

DecayFnct = Moderate   Dist = 1000   Weight = 300

☐ Now open the linear_disturbances table and use the Type field and again write down the DecayFnct, Dist, and Weight for both Paved and Improved Dirt Roads.

Paved--   DecayFnct = Abrupt   Dist = 100   Weight = 300
Improved Dirt-- DecayFnct = Moderate   Dist = 200   Weight = 200

☐ From these three features we will now calculate the project impact area following the GIS steps identified within the Mongolia Offset Regulations and as discussed in your lecture. Briefly write down the four steps here:

1) Buffer each land disturbance by the maximum impact distance

2) Calculate continuous impact magnitude values for each land disturbance

3) Create a cumulative impact area

4) Categorize cumulative impact area three magnitude zones; high, med, low.

☐ The first step is to buffer each land disturbance by the assigned maximum impact distance. We will now go through this process for the three land disturbance features.

☐ Open the Euclidean Distance tool located within ArcToolbox>Spatial Analyst Tools>Distance toolset. Select the Ld _FencedAreaOnly layer as the input, place the output within your MDT_Output folder and name it EcDistFencedArea.img, set the Maximum distance to the Dist value you wrote down associated with the Fenced area type located in the area_disturbances table , set the Output cell size to 10, and keep the Output direction raster input blank. The dialog should look exactly like the one below.
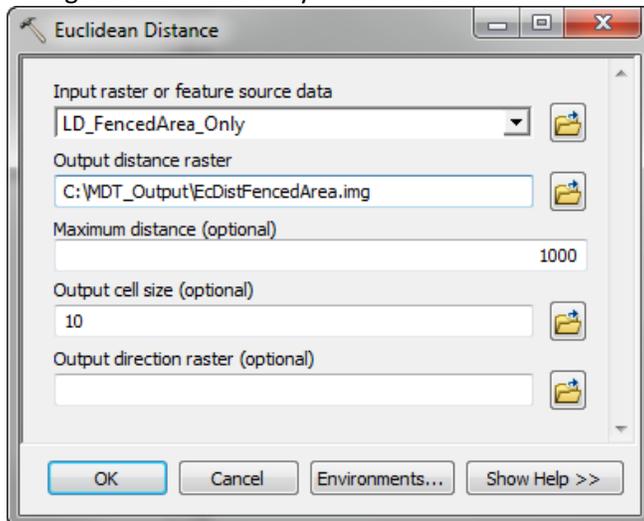
NOTE: Several environmental settings were already established within this MXD document. The analysis extent was set to an extent 1000 meters greater than the LD_FencedArea_Only layer extent. This insures the new raster dataset produced (i.e. EcDistFencedArea.img) would produce cell values beyond the extent of the feature class being used by the Euclidian Distance tool which is the default for ArcGIS. Additionally a default raster cell size of 10 was set and a snap raster was set thus making sure all raster datasets had the same cell size and theses cells aligned with each other.

☐ What are the cell values for the cells within the fenced area? 0

☐ Now make the Ld_Linear_Outside_Fence layer the only visible layer and select the Paved Road feature using the either the Select tool or by using the Select by Attributes dialog.

☐ Once selected use the Euclidian Distance tool following the same procedures as above but using the distance information specific for Paved Roads and assign the name, EcDistPavedRd.img. The dialog should look like the one below.
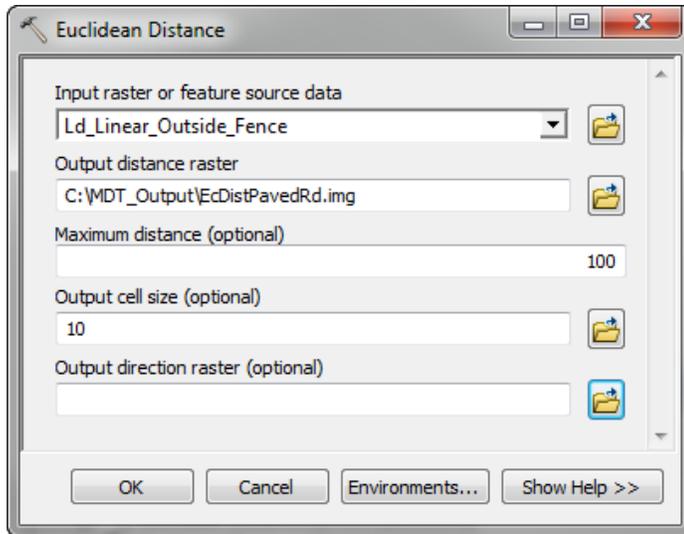
☐ Next select the Improved Dirt Road feature from the Ld_Linear_Outside_Fence Layer and use the Euclidian Distance tool with the distance information specific for the Improved Dirt Roads. Name the output as EcDistImpDirtRd.img. The dialog should look like the one below.
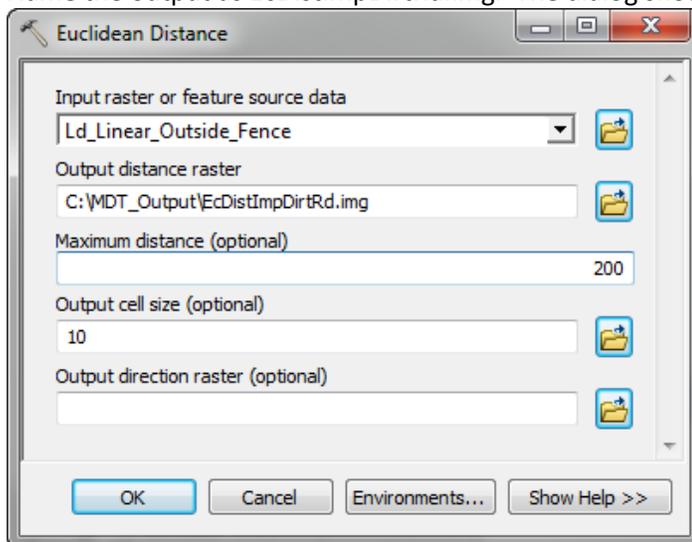
☐ Clear all selections by going to the Select menu and clicking on Clear Selected Features tool.

☐ Now that we have the Euclidian distance values for each disturbance, we now need to calculate the continuous impact magnitude values for each land disturbance.

☐ With these Euclidian distance raster datasets we will now apply the decay function associated with each feature to derive the continuous impact magnitude values. From the lecture, write down the two decay function formulas we will be using (i.e. Moderate and Abrupt) for our three land disturbances.

Abrupt: $Weight / (1 + Exp(((Distance / (Max\_Distance/20)) - 1) * 5))$
Moderate: $Weight / (1 + Exp(((Distance / (Max\_Distance/20)) - 5) * 1))$

☐ For each land disturbance (i.e. fenced area, paved road, and improved dirt road) write down the formula inputting the appropriate values for the Weight, Distance and Max_Distance variables.

Fenced Area – **300**/(1 + Exp((("EcDistFencedArea.img" / (**1000**/20)) - 5)*1))

Paved Road - **300**/ (1 + Exp ((("**EcDistPavedRd.img**" / (**100**/20)) - 1) * 5))

Improved Dirt Road - **200**/(1 + Exp((("EcDistImpDirtRd.img "/ (**200**/20)) - 5)*1))

☐ Now open the Raster Calculator tool located within ArcToolbox>Spatial Analyst Tools>Map Algebra and input your formula for the fenced area. Set your output to the name ImpactFencedArea.img. Your dialog should be the same as below. NOTE: It is important to place the parentheses correctly.
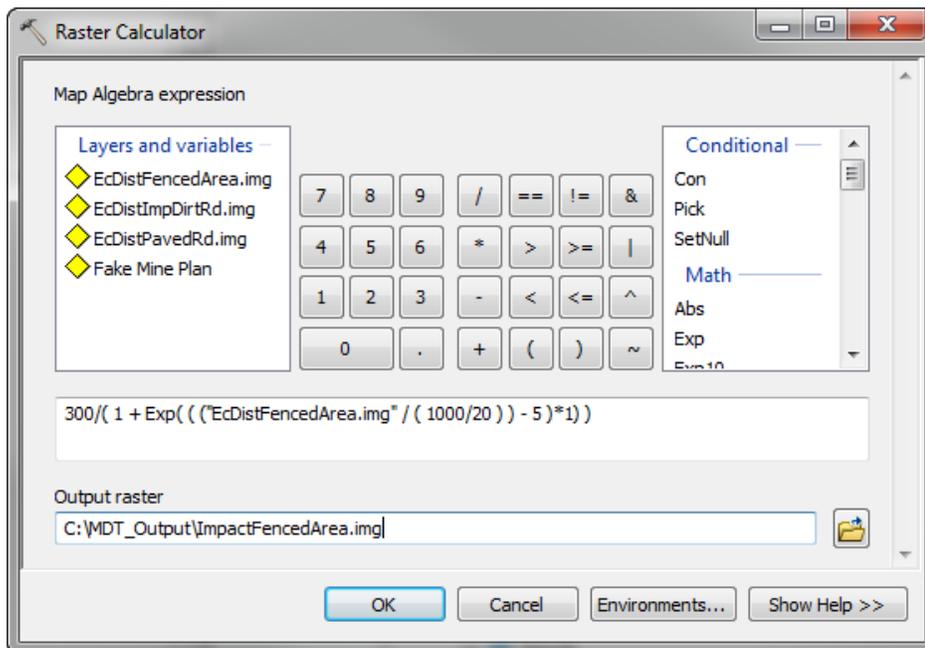
☐ Using the Raster Calculator tool do the same for the Paved Roads and assign the output to the name ImpactPavedRd.img. Your dialog should be the same as below.
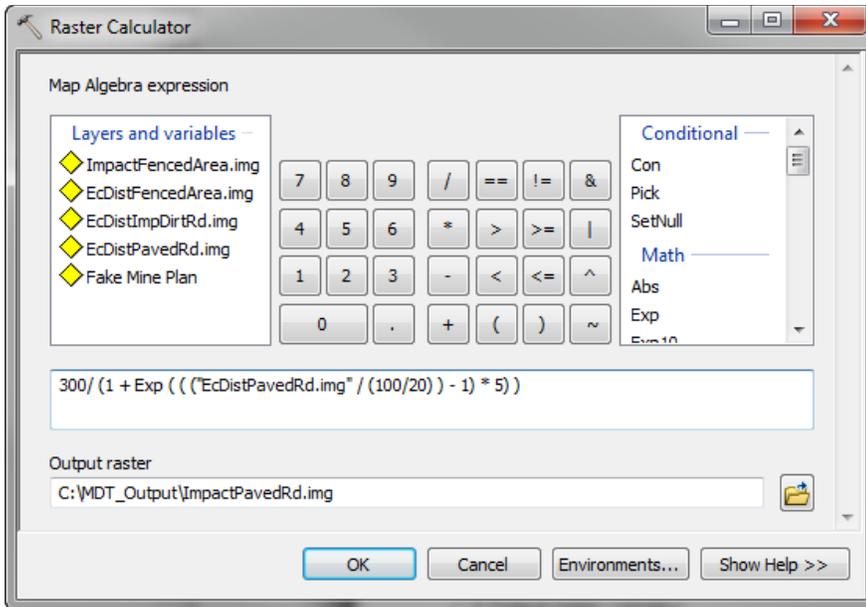
☐ Using the Raster Calculator tool do the same for the Paved Roads and assign the output to the name ImpactImpDirtRd.img. Your dialog should be the same as below.
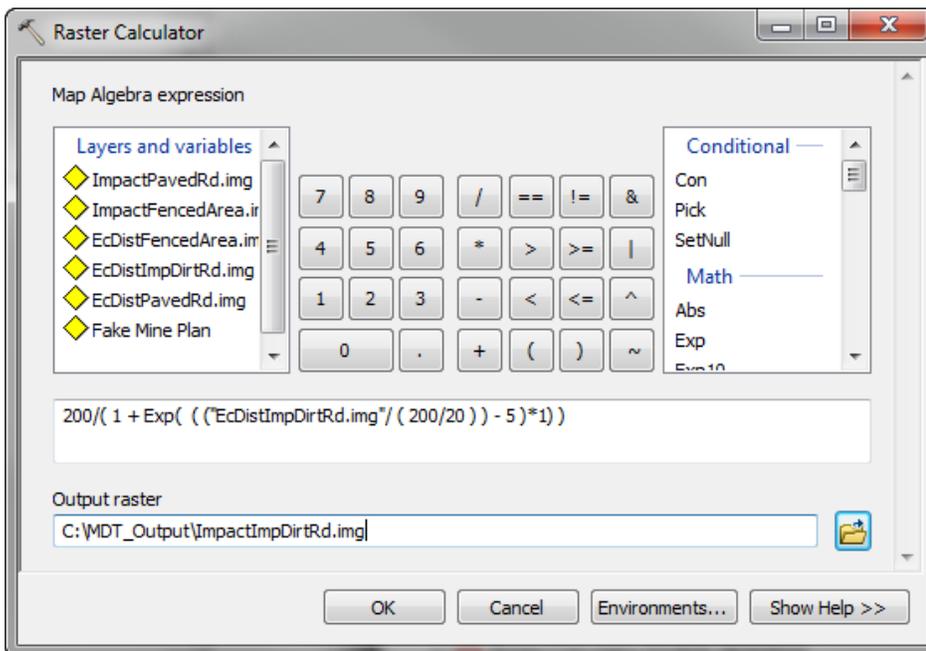
☐ What is the highest cell value for ImpactImpDirtRd? 198.661

☐ Where are these highest cell values located compared to the Improved Dirt Road layer? Those cells overlapping the road.

☐ What is the lowest cell value for ImpactFencedArea.img? 0.0000917707

☐ Where are these lowest cell values located compared to the Fenced Area? 1000 meters away from fence

☐ With each land disturbance having an individual continuous impact magnitude raster datasets calculated, we will now combine all three of these datasets to produce one project impact area with continuous magnitude values.

☐ Open the Cell Statistics tool located in ArcToolbox>Spatial Analyst Tools > Local and add the three impact raster datasets (i.e. ImpactFencedArea.img , ImpactPavedRd.img, ImpactImpDirtRd) as Input rasters, assign the output name to ImpactAllMax.img, select MAXIMUM for an Overlay statistic and make sure the check box is checked in front of Ignore No Data in calculations (optional). Your dialog should look exactly like the one below.
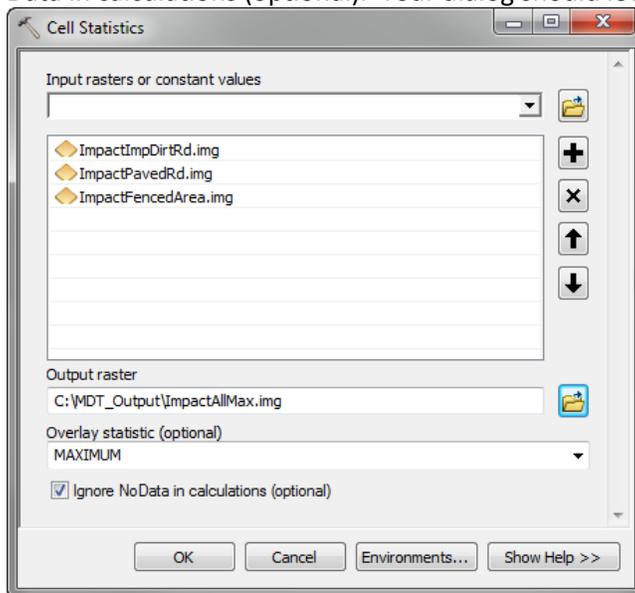
☐ Click the OK button

☐ What is the highest value associated with the ImpactAllMax.img? 297.992

☐ Where are these highest value cells located? Within the fenced area and on the paved road.

☐ Now the final step is to categorize the project impact area into three categories of high, medium and low impact.

☐ Due to ArcGIS having difficulties categorizing floating point raster datasets, we will first modify the project impact area with continuous magnitude values that was just created so it only has integer values associated with it.

☐ Open the Int tool located within ArcToolbox>Spatial Analyst Tools>Math toolset. Assign the ImpactAllMax.img raster as the Input and set the output name to ImpactAllMaxInt.img. Your dialog should be exactly like the one below.
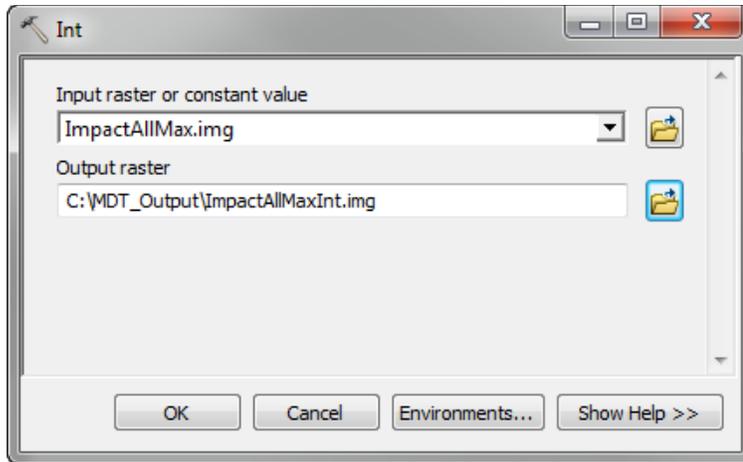
☐ Click the OK button.

☐ What is the highest value associated with ImapctAllMaxInt.img? 297

☐ Now we are ready to categorize these data. Open the Slice tool located within ArcTooblox>Spatial Analyst Tools>Reclass toolset. Assign the ImpactAllMaxInt.img raster dataset to be the Input raster, name the output as ProjectImapctAreaCats.img, set the zones to 3, assign the Slice method as EQUAL_INTERVAL and have a Base zone for output as 1. Your dialog should look exactly like the one below.
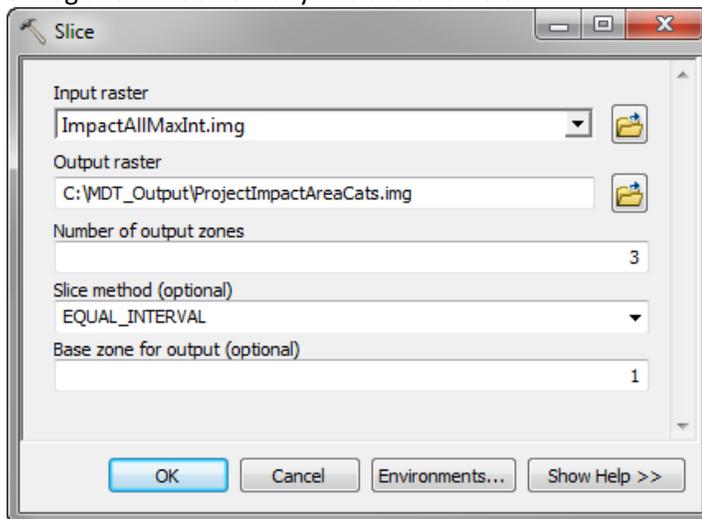
☐ Click the OK button.

☐ Examine the output, which land disturbance has the most influence on the categorization? Fence Area

☐ Which land disturbance has a smallest role in assigning the categories and cannot be seen in the categorized data? Improved Dirt Road

- ☐ What category is associated directly with the location of the paved road? High

- ☐ Congratulations you have now created a project impact area which can be used for the Mongolia Offset Regulation offset cost calculations.

- ☐ Now let's run the MDT-Desktop tool for comparison. Open the Step 2 – Calculate Project Impact Area tool within ArcToolbox>MDT>Land Disturbance and Impact Tools. Set the Ld_Linear_Outside_Fence layer as the Land Disturbances – Linear Feature and select the LD_Code field for the Field Name for Land Disturbance Type. Set the Area Features to the LD_FencedArea_Only layer and select its LD_Code field for the Field Name. Finally output the Project Impact Raster Dataset with the name ProjectImpactTool.img. Your dialog should look the same as the one below. NOTE: Make sure none of the land disturbance features are selected before running the tool.
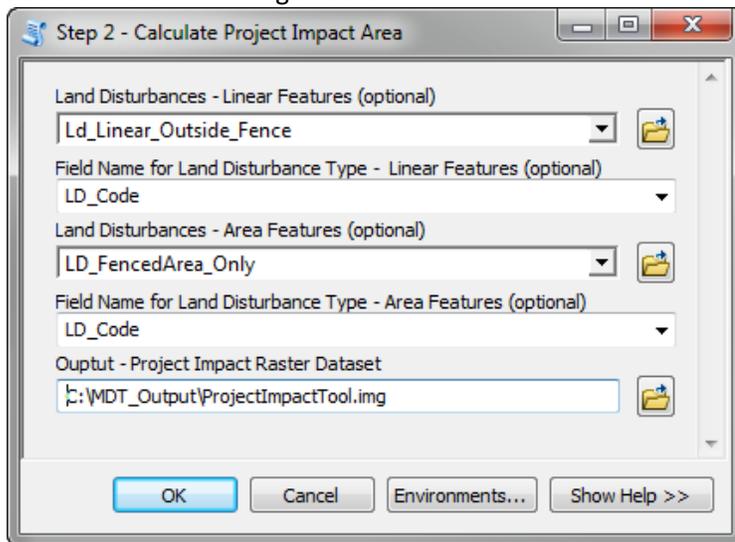
- ☐ Click the OK button

- ☐ Compare this raster dataset with the one you created following the GIS steps. Besides the legend, what is the only difference between the ProjectImpatTool.img and ProjectImapctAreaCats.img you created previously.

  Attribute values are different, with 30 being 3, 20 being 2 and 10 being 1.

- ☐ Close ArcMap without saving.

Exercise #3

Exercise 3a – Calculating Site Condition Offset Factor

☐ Open EX_3a.mxd within the MDT_Training/Exercises folder.

☐ By just looking at the Disturbance Index for the Gobi (i.e. Disturbance_Index.img), which portion of the Gobi appears to be the least disturbed?

Southwest portion

☐ From the lecture, name the two locational offset factors which use the disturbance index as an input in creating the factor.

Site Condition and Category of Habitat

☐ From the lecture, what are the descriptions for the three offset categories (Good, Medium, Low) associated with Site Condition?

3 (Good) - least disturbed 50% of the landscape (i.e. <50 percentile of the disturbance index)
2 (Medium) – The 45% of cells having disturbance values above *Good* and below *Low* (i.e. 50 – 94 percentile of the disturbance index)
1 (Low) - the most disturbed 5% of the landscape (i.e. > 95 percentile of the disturbance index)

☐ Open up the table for the Disturbance Index, using the Statistics command on the COUNT field. What is the total number of cells found in this dataset? 3,485,056

☐ How many cells are 5% of the total? 174,252.8

☐ Due to there not being a tool which accurately assigns percentiles to raster cell values, you will be using a custom tool created by TNC to assign percentiles.

☐ In the Catalog window go to MDT_Training/Exercises/AdditionalTools. Within this folder there should be a toolbox named Percentiles. Open the toolbox and select the Assign Percentiles tool. Select the Disturbance_Index.img as the Input Raster and name the Output as DI_Percentiles.img. Your dialog should look the same as the one below.
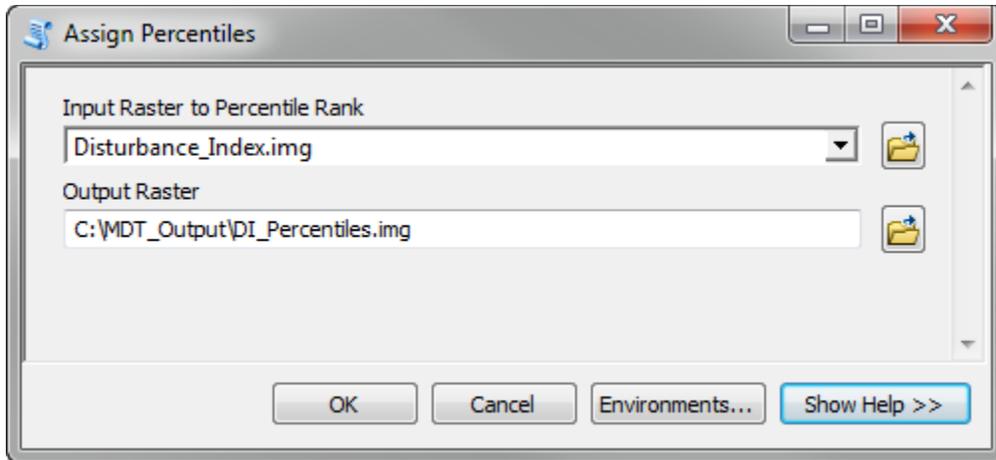
☐ Click the OK button

☐ Examine the DI_Percentiles.img raster dataset. Can you explain why the lowest cell value 12.7712 (if not skip to the next question)?

The input disturbance index raster dataset has 12.712% of its cells assigned with the value of 0.

☐ Open the Disturbance_Index.img attribute table. You will see there has been a new field, pctVal, has been created with each disturbance index value having an assigned pctVal. Can you now explain why the the lowest cell value for DI_Percentiles.img is 12.7712?

☐ To create the Site Condition offset factor we now need to categorize the DI_Percentiles.img into three categories. To do this we will use the Reclassify tool located within ArcToolbox>Spatial Analyst Tools > Reclass toolset. Select DI_Percentiles.img as the Input raster, set the Reclass field to the Value field, and assign values of less than or equal to 50 to the value of 3 (i.e. 0 -50), 50-95 to a value of 2, and 95-100 to a value of 3. Name the output to SiteCondtion.img. Your dialog should look similar one below.
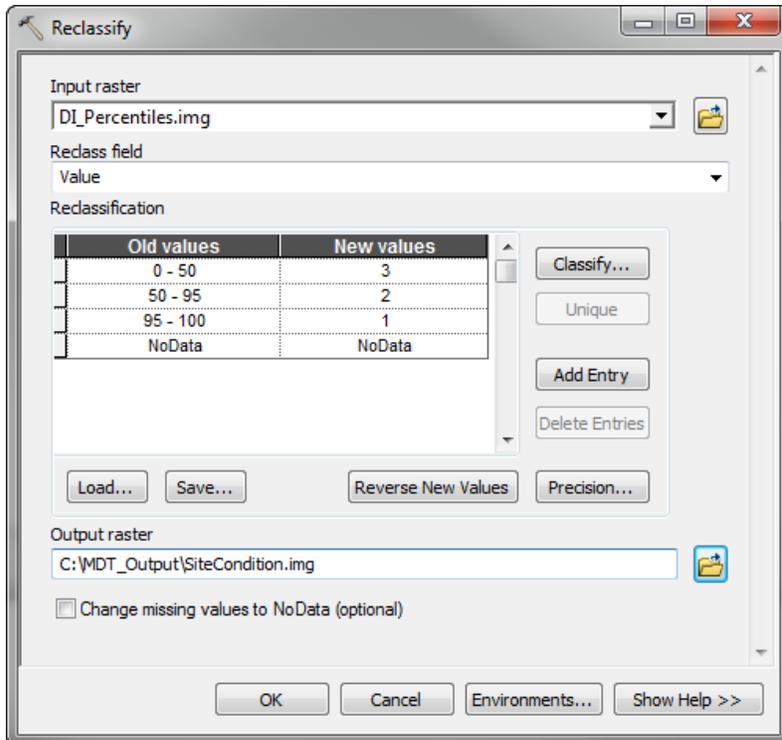
Note: If there had been values of 50 or 95 you would have had to make sure the range accounted for that since the Mongolian Offset Regulation states the Good category (i.e. value 3) needs to be the least disturbed 50% of the landscape (i.e. $\leq$ 50)

☐ Open the attribute table, how many cells fall into value 1 (i.e. category Low)? 174,896

☐ Why is this value not exactly the same as the 5% you calculated previously?

Disturbance Index is an integer raster and thus has multiple cells with the same values. This will cause a slight difference since the calculated 5% only is accurate if all cell values have different values.

☐ You have now created the Site Condition Offset Factor, congrats. Which category of the Site Condition Offset Factor is used in calculating the Habitat Category offset factor? Low - 1

☐ Close ArcMap without saving.

Exercise 3b – Calculating offset costs

☐ Open EX_3b.mxd within the MDT_Training/Exercises folder.

☐ Examine the spatial relationship between the Project Impact Area (i.e. ProjectImpactArea.img) and the four locational offset factors. From what you learned from the lecture, can you guess which offset factor will produce the highest cumulative offset units for that factor?

Site Condition since it appears to have more High Impact Areas within the High and Medium categories than the others.

☐ We are now going to calculate the total offset units for one factor, Site Condition. From the lecture, what are the steps necessary to calculate the offset units?

Step 1) Intersect project area impact raster dataset with each locational offset factor
Step 2) Calculate hectares for all nine possible combinations
Step 3) Calculate offset units for each combination based on ratios
Step 4) Summarize all offset units

☐ First we need to intersect the Project Impact Area with the Site Condition offset factor.   Since the Project Impact Area has cell values of 30, 20, or 10 and the Site Condition offset factor has cell values of 3, 2, or 1, the best way to identify the unique categories produce by intersecting these two layers would be to sum the overlapping cell values. Before doing this however it is always important to compare the raster resolution of the two datasets being used. List the resolution of each raster here:

Project Impact Area = 10 meters
Site Condition = 389.071363 meters

☐ In order to maintain the cell size of the Project Impact Area throughout the analysis, we need to insure the cell size used in any raster analysis is set to its cell size of 10 meters. Click on the Geoprocessing menu and select Environments.   Within the Environment Setting dialog expand the Raster Analysis section and set Cell Size to same value as the ProjectImpactArea.img layer. Your Environment Setting dialog should be similar to the one below.
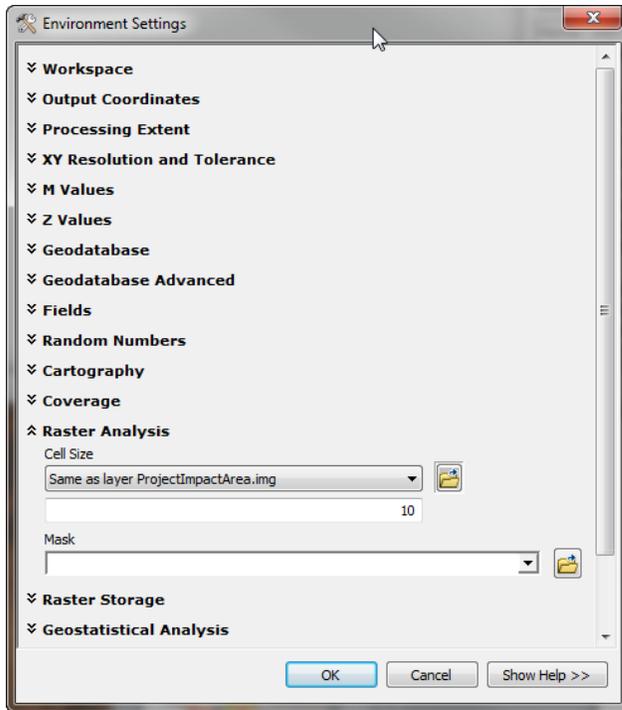
☐ Click on the OK button.

☐ Now open the Plus tool within ArcToolbox>Spatial Analyst Tools>Math toolset. Add the ProjectImpactArea.img and Site Condition layers to the tool and output the name of the dataset as ImpactSiteCon.img. Your dialog should look exactly as the one below.
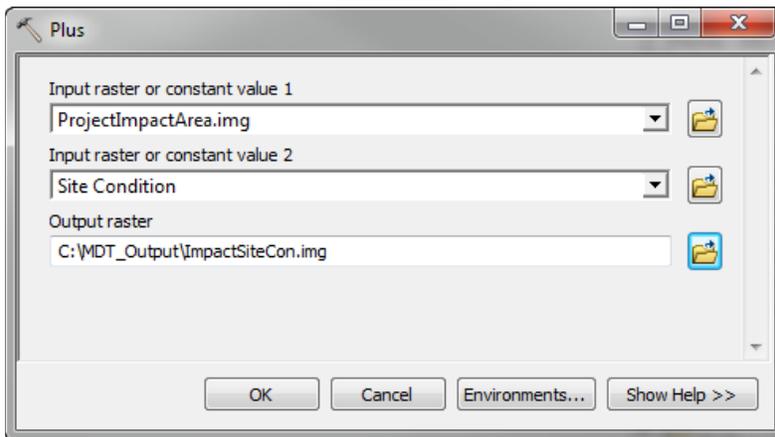
☐ Click on the OK button

☐ Open the attribute table associated with ImpactSiteCon.img. Why are there only six values instead of nine?

Not all of the possible nine combinations are present when summing these two raster layers.

☐ What does the value 33 indicate?
High impact area overlapping a good site condition.

☐ We now need to calculate the hectares for each category. Add a field named HA with a type of Double to this attribute table.

☐ Now we need to determine how many hectares or partial hectares are associated with each cell. Write down this value knowing that each cell has a resolution of 10 meters (i.e. an area of 100 sq meters).

One cell = 0.01 hectare or 1/100th of a hectare

☐ Now using your knowledge of the partial hectares per cell calculate the HA using the calculate tool. Your calculate dialog should look like the one below with the formula [Count]/100.
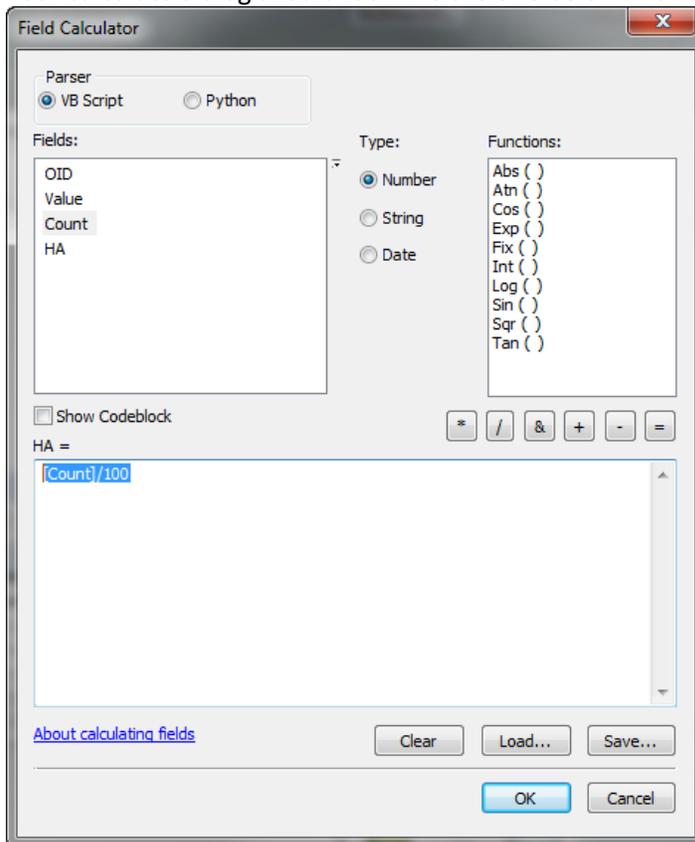
☐ Click the OK button

☐ Now that we have the calculate hectares we need to identify the offset units based on the offset ratios. Add a field named OffUnits with a type of Double to the ImpactSiteCon.img attribute table.

☐ Use the table below and the Field Calculator to calculate each categories offset units. For example those cells with a value of 32 would have the HAs multiplied by 1.5 to obtain the offset units. You will need to select each record separately and then run the calculation based on the appropriate values

.

Locational Factor Category

Impact Category	High (3)	Medium (1.5)	Low (0.2)
High impact (1)	**33**: 3	**32**: 1.5	**31**: 0.2
Medium impact (0.66)	**23**: 1.98	**22**: 0.99	**21**: 0.132
Low impact (0.33)	**13**: 0.99	**12**: 0.495	**11**: 0.066

☐ Once you have calculated all offset unit values, write down the total offset units when summing all categories.

2,469.4092 offset units

☐ If you were to continue on to calculate the total project offset units, what other steps would be necessary?

You would first run this analysis on the remaining three offset factors (i.e. Category of Habitat, Landscape Positioning, and Ecosystem Type) and calculate the project duration. Then sum the offset units of all factors.

☐ Fortunately we have customized a tool to do all of these steps. Open Step3 – Calculate Offset Cost Report tool within Toolbox>MDT>Offset Tools. Set the Project Name to Oakleaf, select the ProjectImpactArea.img layer for the Project Impact Area Raster, set the Project Duration to Medium (5 – 20 years) and finally set the output file name to MDT_CompareSC.html. Your dialog should look exactly like the one below.
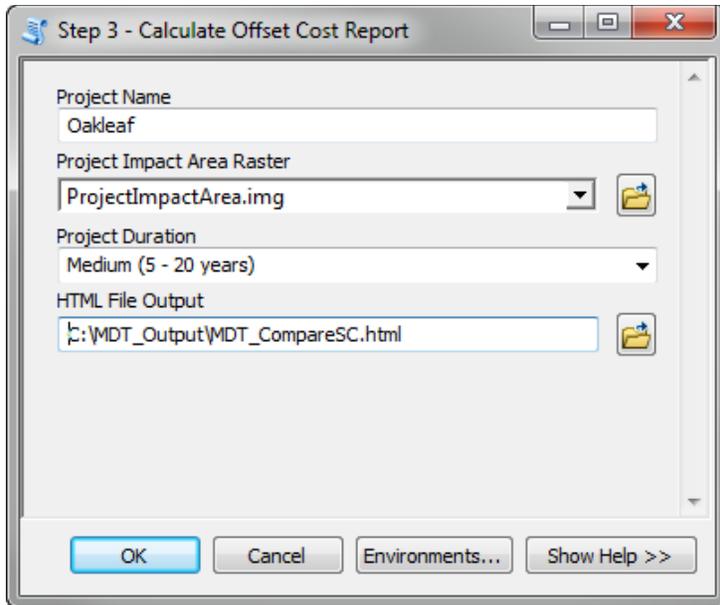
☐ Click the OK button.

☐ Find the Site Condition table, what are total offset units for this offset factor? 2,469 offset units

☐ Close the MDT_CompareSC.html file and close ArcMap without saving

Exercise 3c – Selecting Potential Offset Sites

☐ Open EX_3c.mxd within the MDT_Training/Exercises folder.

☐ Use the Soums and Aimags layer to determine what Soum and Aimag, the Project Impact Area (i.e. ProjectImpactArea.img) occurs in?

Noyon Soum and O'mnogovi Aimag

☐ We are now going to select potential offset sites for this project impact area. From the lecture, what are the two major steps in identifying these sites

1) Calculate size and type of ecosystems impacted by project impact area
2) Identify sites which have matching ecosystems with the same or more of each type impacted

☐ The first step is to determine the impacted ecosystems and the corresponding area impacted for each ecosystem.   To accomplish this we first want to create a Project Impact Area raster dataset that just identifies the overall impacted area. One method of doing this would be to set all cell values within the ProjectImpactArea.img layer to 1.

☐ Use the Con tool located under ArcToolbox>Spatial Analyst Tools>Conditional toolset.   Select the ProjectImpactArea.img layer as the Input conditional raster, set your expression to be true for all positive cell values (i.e. "Value" > 0), set the Input true raster or constant value to 1, leave empty the false raster, and output your data to Ones4PrjImpact.img. Your dialog should look like the one below.
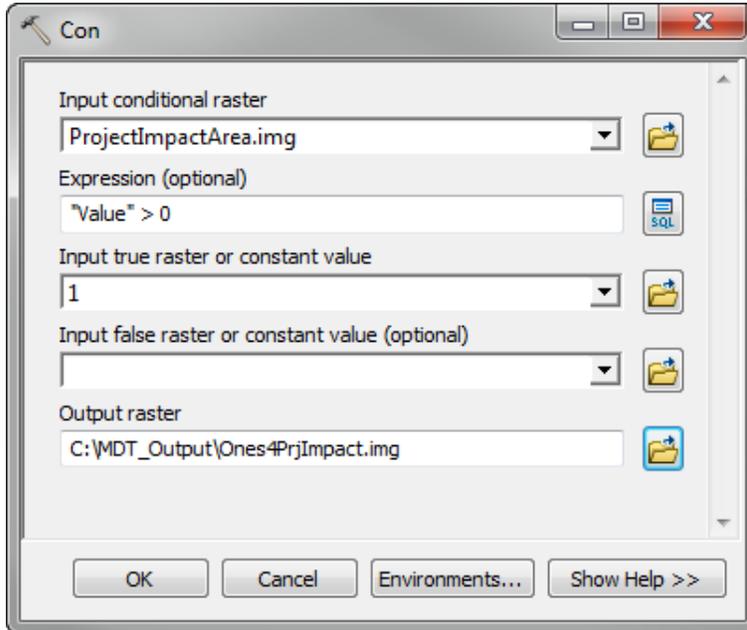
☐ Click the Ok button.

☐ Now we want to determine for each project impact cell, the Ecosystem type being impacted. Before doing so, use the Ones4PrjImapct.img layer to set the Geoprocessing Environmental setting of the Raster Analysis - Cell Size. (Hint: Similar to what you did in EX_3b). What is this cell size? 10 meters

☐ Since we set all Project Impact Area cell values to 1, we can extract the Ecosystem types associated with the Project Impact Area by using the Times tool located in ArcToolbox> Spatial Analyst Tools>Math toolset. Set the first Input raster to Ones4PrjImpact.img and the second to Ecosystems. Set the output name to ImpactEcosystems.img. Your dialog should look similar to the one below.
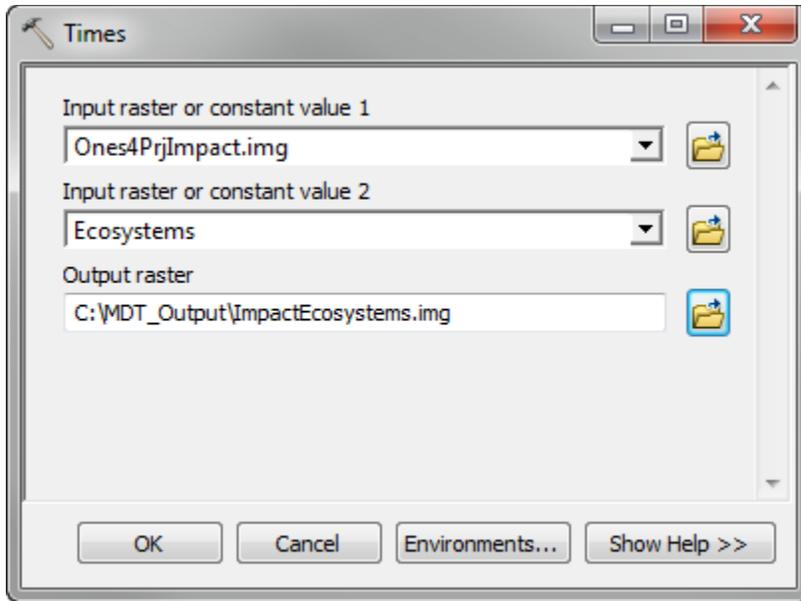
☐ Click the OK button

☐ Using the ImpactEcosystems.img, which ecosystem value is most impacted by the project? 30

☐ Using the Ecosystems attribute table, what type of ecosystem is the value of 30 associated with?
  semi desert

☐ We now need to calculate the hectares for each impacted ecosystems. Since we know the raster cell size is 10, we also know that each cell is 1/100th of a hectare. In the attribute table of the ImpactEcosystem.img layer, create a new field name HA with the type double. Calculate the hectares for each ecosystem by dividing each cell count by 100 (i.e. [Count]/100). How many hectares of the semi desert ecosystem are impacted? 725.85

☐ Open the offset cost report you created in Ex3b (i.e. MDT_Output/ MDT_CompareSC.html). Click on the Land Disturbance Impacts quick link at the top of the page. Look at the Ecosystem Impacted with Noyon Soum table. Do your hectares match with the report? If not, either redo the calculations or use the copy of the table below to move forward in the exercise.

Ecosystem (ES) Impacted within Noyon Soum

ES Code	ES Category	Hectares Impacted
13	true desert	259.08
30	semi desert	725.85
51	wet depressions, small basins 100-1,000 km2	686.92
91	seeps dense vegetation	43.44

☐ Now using the amount of ecosystems impacted you will need to identify potential portfolio sites which contain at least the same ecosystems and hectares of those ecosystems impacted.

☐ First we will look at portfolio sites within Noyon Soum. Open the attribute table of the SoumPorfolioWithAtts layer. How many these sites are found within Noyon Soum (i.e. have Noyon as a value within the NAME field)?   1

☐ Within the SoumPorfolioWithAtts attribute field, find the field HA_13. This identifies the number of ecosystem hectares associated with ES Code 13 (i.e. true desert) which are found within the portfolio site. Does the one portfolio site within the Noyom Soum have as many or more hectares of the true desert ecosystem as what is impacted by the project impact area?   Yes

☐ Now compare all the ecosystem hectares within this one portfolio site within Noyom Soum. Does it meet the overall offset site requirements necessary to be selected as an offset for the impacted area?   No

☐ What is ecosystem type is lacking the necessary hectares? Seeps dense vegetation

☐ Now using the AimagPorfolioWithAttts layer, identify the number of potential offset sites within the O'mnogovi Aimag (i.e. NAME = "O'mnogovi"). How many potential sites are there?   29

☐ To determine how many potential sites meet the offset requirement you would have to go through each of the 29 portfolio sites found in the O'mnogovi Aimag or write a lengthy select statement to query the potential matching sites from the layer. Additionally you would then repeat this for all the portfolio sites at the ERA level. Fortunately you can use the MDT- Potential Offset Sites tool to automatically do this.

☐ Open Step 4 (optional) – Identify Potential Offset Sites within MDT>Offset Tools. Select ProjectImpactArea.img as the Project Impact Area Raster, select your MDT_Output folder as the Output Folder and keep both items checked. Your dialog should look the same as below. Note: If you mapped your output folder within ArcCatalog, you will need to select this folder from another mapped folder (e.g. C:\) since a mapped folder cannot be set as a folder output workspace within the dialog.
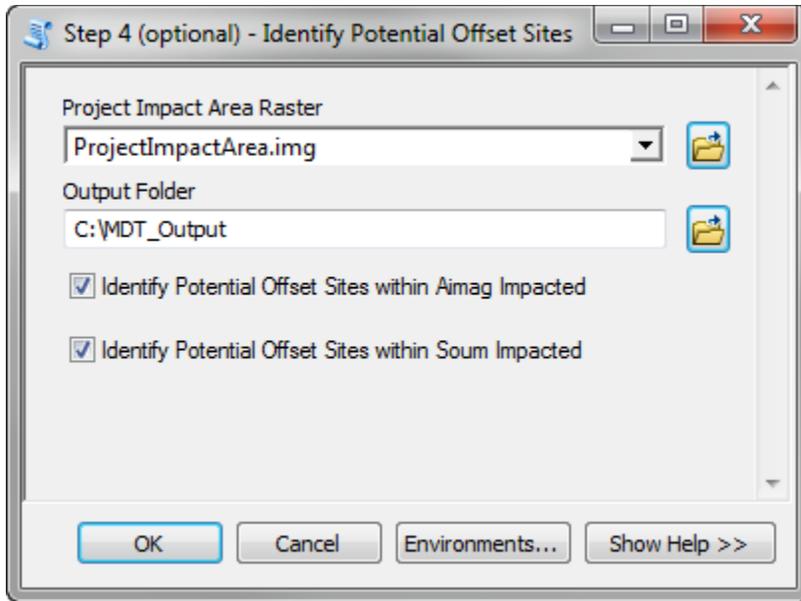
☐ Click on the Ok button.

☐ Open the attribute table of the OffSites_in_O_mnogovi_Aimag layer, using the dist_away field identity the AREANAME of the closest potential offset site for the project impact area? Govi gurvan saixan

☐ Open the attribute table of the OffSites_In_Gobi_ERA and identify by AREANAME the closest potential offset site for the project impact area? Govi gurvan saixan

☐ How are these two potential closest offset sites different?

The Govi gurvan saixan site within the OffSites_In_Gobi_ERA includes the entire portfolio site while the other only includes those lands located within O'mnogovi Aimag.

☐ Close ArcMap without saving

Ex. 4 – (Optional) Using Supplementary Avoidance Tools to Lower Offset Costs.

☐   From Ex1b, look back and identify the time it required you to calculate a Project Impact Area.

Answers will vary however for my computer it took roughly 10 min

☐   Open the cost report for this planned development (i.e. MDT_Output\Oakleaf.html)?   What were the overall yearly offset costs associated with this development? $165,619

☐   Open EX_4.mxd within the MDT_Training/Exercises folder.

☐   Open the Land Disturbances – Locational Offset Cost and Restrictions Assessment Tool found within ArcToolbox>MDT>Supplementary Avoidance Tools. Input the appropriate values and output your Assessment to the name LC_CostAssessment.shp. Keep default items checked. Your dialog should look like the one below.
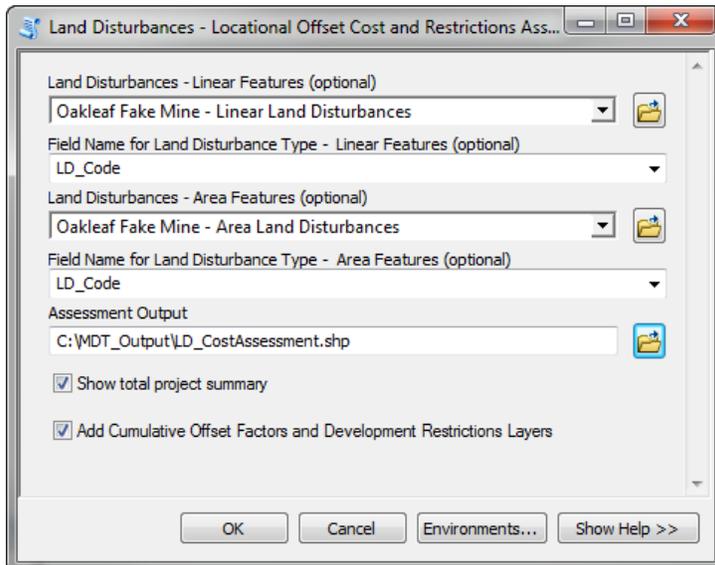
☐   Click on the OK button.

☐   How long did this tool take to complete? Answers will vary but it was only 31 secs for me

☐   What was the total summary COF value for all land disturbances (Hint: This is displayed in the geoprocessing results dialog)?   714,432

☐   What was the highest cost land disturbance feature? Temporary Camp

☐   Comparing the Temporary Camp with the Cumulative Offset Factors, what could you do to lower your offset costs with this land disturbance given it must stay connected to the same road?

Move it to the west to place the entire feature and 1000 meter buffer completely within the green area.

☐ List any other potential spatial modification which could lessen offset costs?

1. Design multi-track road go straight east to main road
2. Create only one road
3. Move the temporary camp to the east side of the project area.
etc

☐ Are there any land disturbances crossing development restriction areas?

Yes, the transmission line

☐ Make a copy of the linear and area land disturbances and place them in your output folder with the names of ModifiedLDLinear.shp and ModifiedLDArea.shp. One method of copying the data, is to use the Copy Features tool within ArcToolbox>Data Management Tools>Features toolset. Your dialog for the linear features would look like the one below.
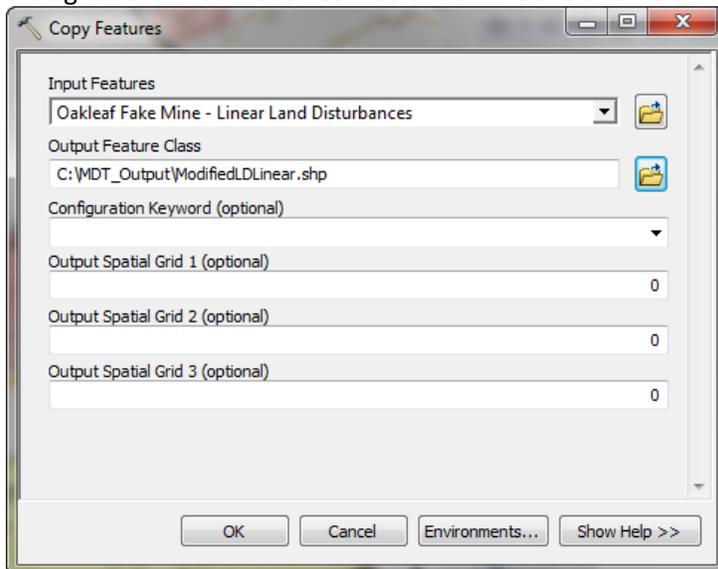
☐ Now start an edit session and do the following edits to these copied land disturbances:

  o Move the Temporary Camp to the west making sure the camp is to the west enough to completely have its impact area within the green area (i.e. COF value of 62) of the Cumulative Offset Factors.

  o Make the multi-path road run more east-west in a straight line. Avoid the restricted area and connect this road to the main road north of the population center.

  o Assume that there are other transmission lines running along the main road to the east of the development. Modify the transmission lines so it does not overlap with restricted area and have it follow close to the multipath road.

☐ Close your edit session and clear all selections

☐ Now rerun the Land Disturbances – Locational Offset Cost and Restrictions Assessment and assign the name of your assessment output to Modified.shp. This time uncheck the Add Cumulative Offset Factors and Development Restrictions Layers. Your dialog should look similar to the one below. Note: Make sure you have nothing selected from your edit session.
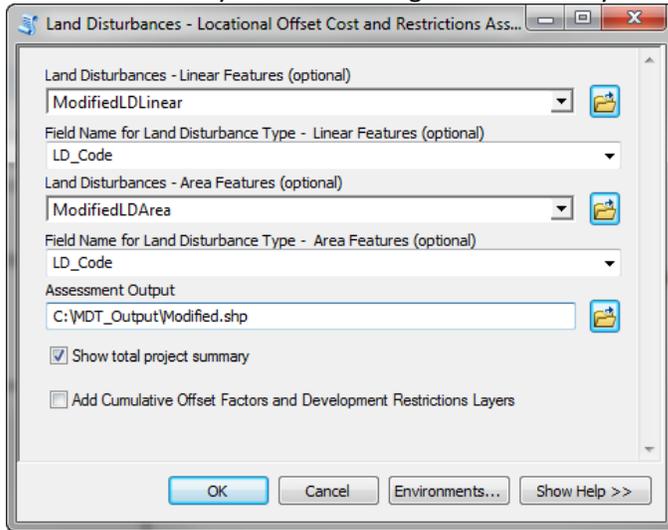
☐ What is the new overall COF value? 699,378 will vary but could be even lower.

☐ Which land disturbance feature now has the highest potential cost value? Mine pit

☐
☐ Now go through the steps and use the appropriate tools to create an offset cost report for these modified land disturbances.

☐ What is the new total offset cost per year with the modified land disturbances using the same duration values as before (i.e. Medium)? Answers will vary but I got a cost of $158,042

☐ How much did that save in offset costs? Roughly $7,00 a year for my solution

☐ Would there still be other ways to possibly save additional offset cots?

Possibilities:
   o   Have the transmission line fall within the multi-track roads
   o   Eliminate one of the roads
   o   Move the temporary camp to the east side
   o   Make the parking lot smaller and within some of the buffered mine pit impacts

☐ Given the mine pit will not move. Try other configurations and try to lower the COF value even further and check out the cost savings.