Collective Appendix

Realising an evergreen dream? (Van Bodegraven, 2006)

and

Dangerous soil erosion!? (Kort, 2006)

C.W. van Bodegraven & A.J.K. Kort

November 2006

Collective Appendix

Realising an evergreen dream? (Van Bodegraven, 2006)

and

Dangerous soil erosion!? (Kort, 2006)

Nairobi, November 2006

This is a collective appendix of the reports Van Bodegraven (2006) and Kort (2006) consisting of collected data matching with both reports.

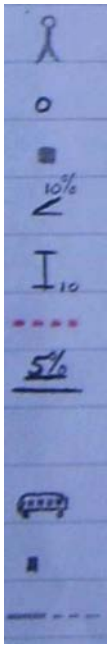
C.W. van Bodegraven & A.J.K. Kort

Table of Content

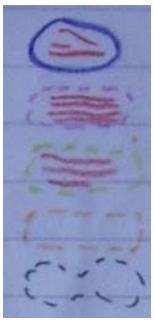
Maps

Legend

Urban area with small plots
Urban area
Agriculture
Pasture plain
(Gemstone) mining
Sisal estate
Government land with illegal structures and plots
Trees
Orange estate
Bush
Pasture bush
Rocky bush
Fallow
Clay winning
Sand winning
Wastewater plain
Sisal factory
Varied bush, agriculture and houses
Varied bush and houses
Varied bush and agriculture



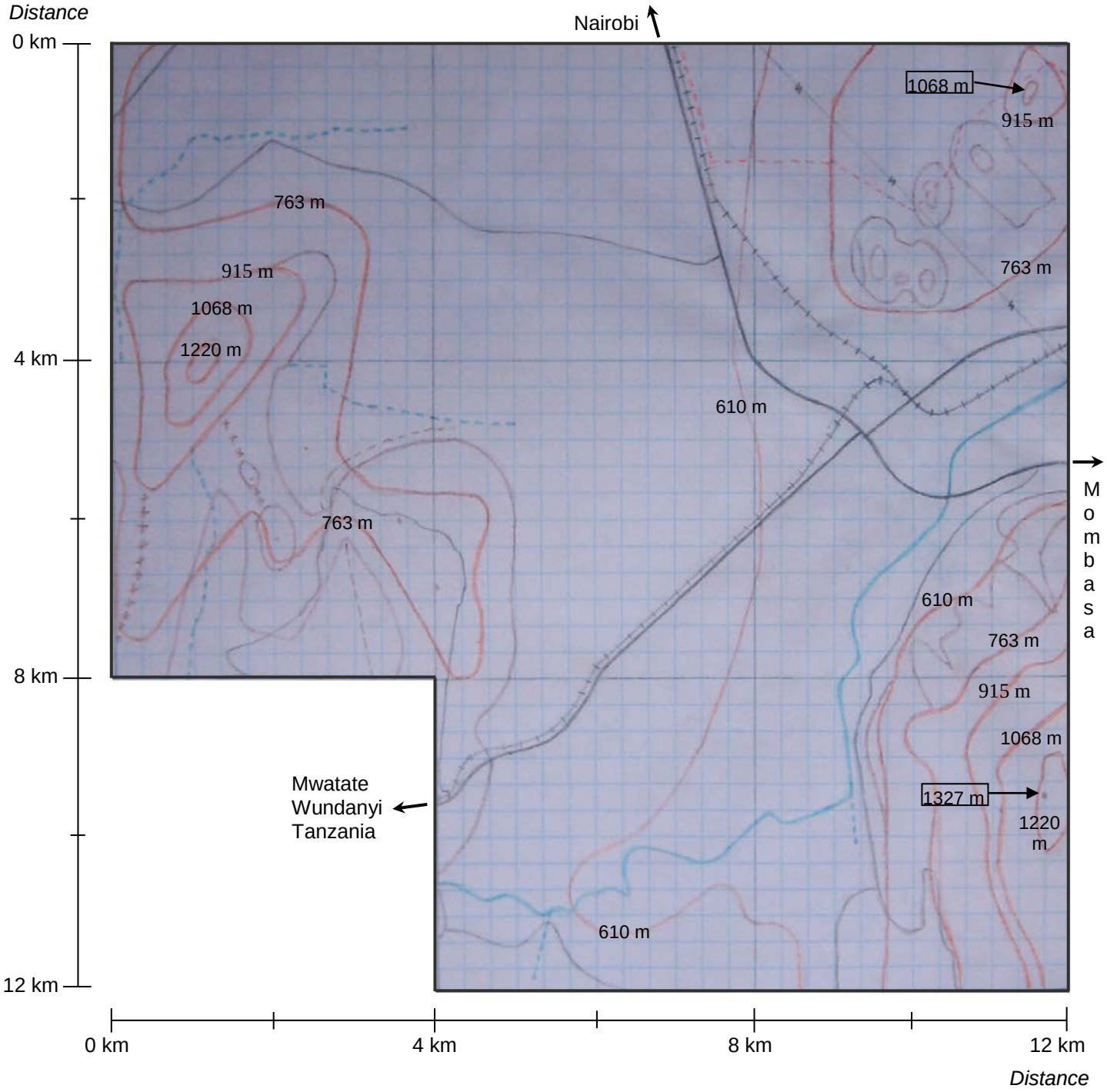
Mast
Borehole
Structure
Slope
Measurement point
Border National Park
Slope (average)
Bus/Matatu station
Structure
Road continues:
direction unknown



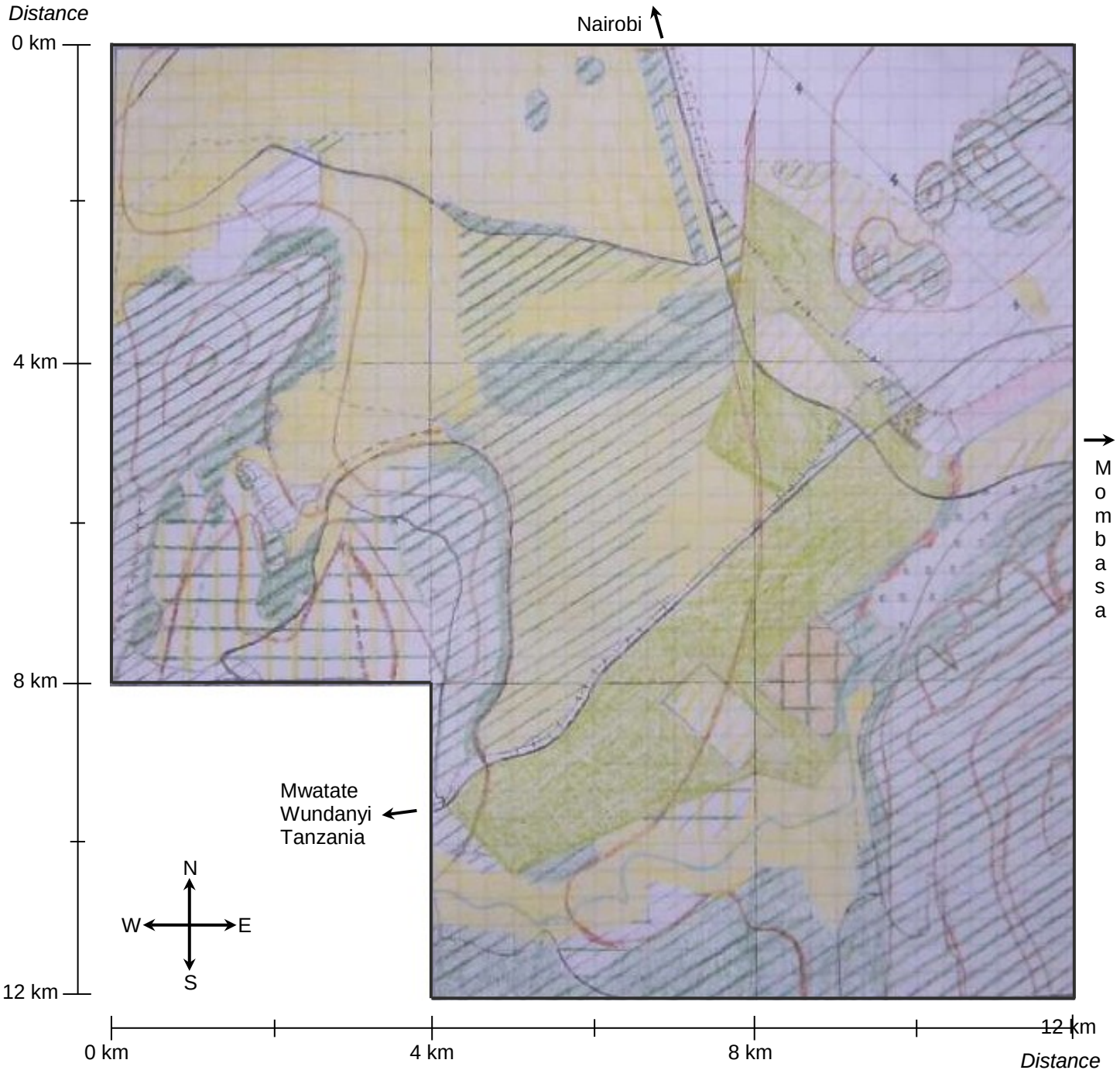
Gullies by piping
Canyon-like gullies
Area influenced by gullies
Gullied area with unknown way of gullies
Gullied area researched by the University of Helsinki

Unpaved road
Paved road
Railway
Electricity line
Gully
Riverbank erosion
Eroded area
Ravine
Enforced riverbank erosion
River
Seasonal flow (wadi)
Dam
Hills shape
Contour line (map)
Crest line
Very steep slope (rock face)

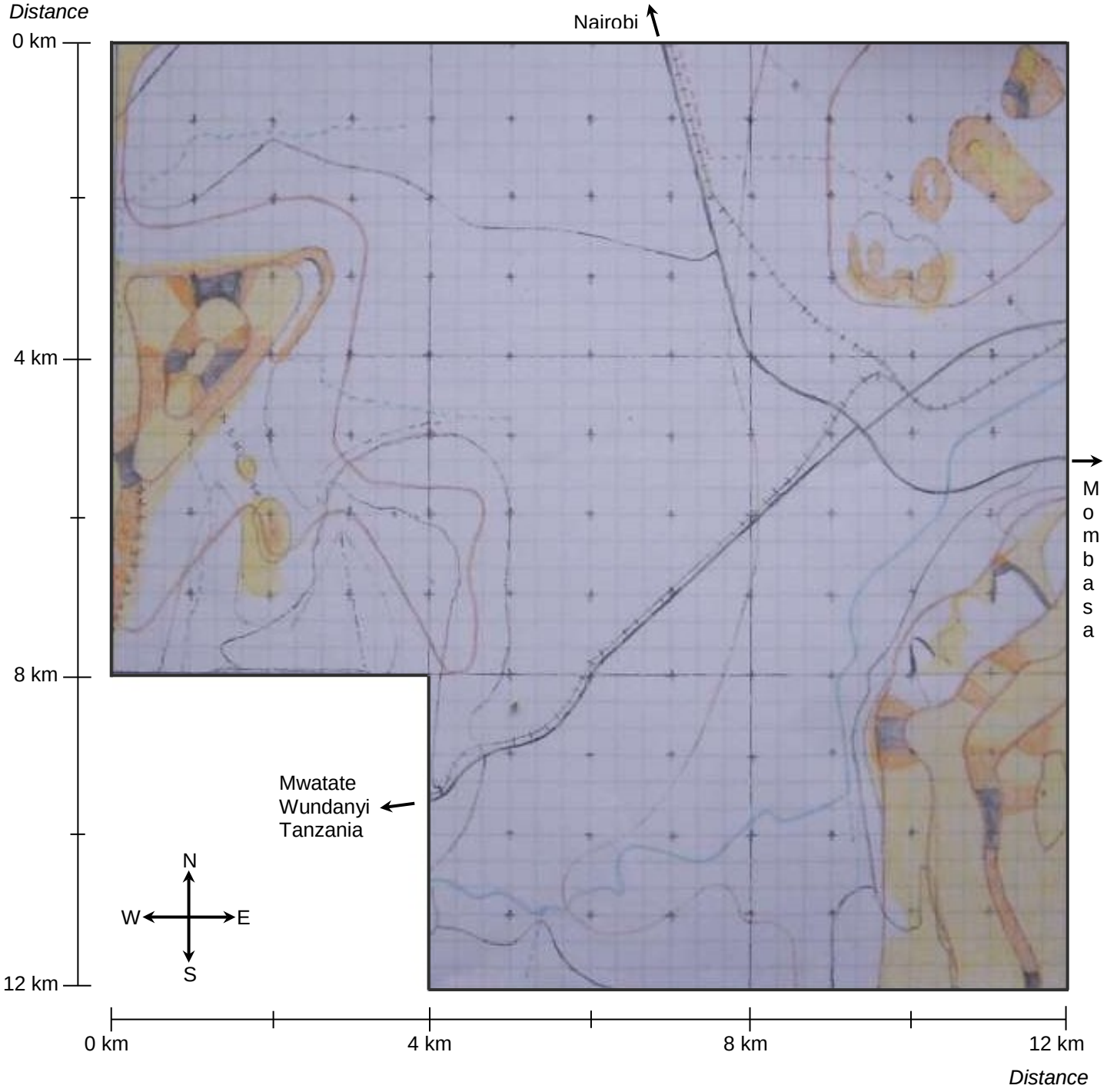
Contour lines



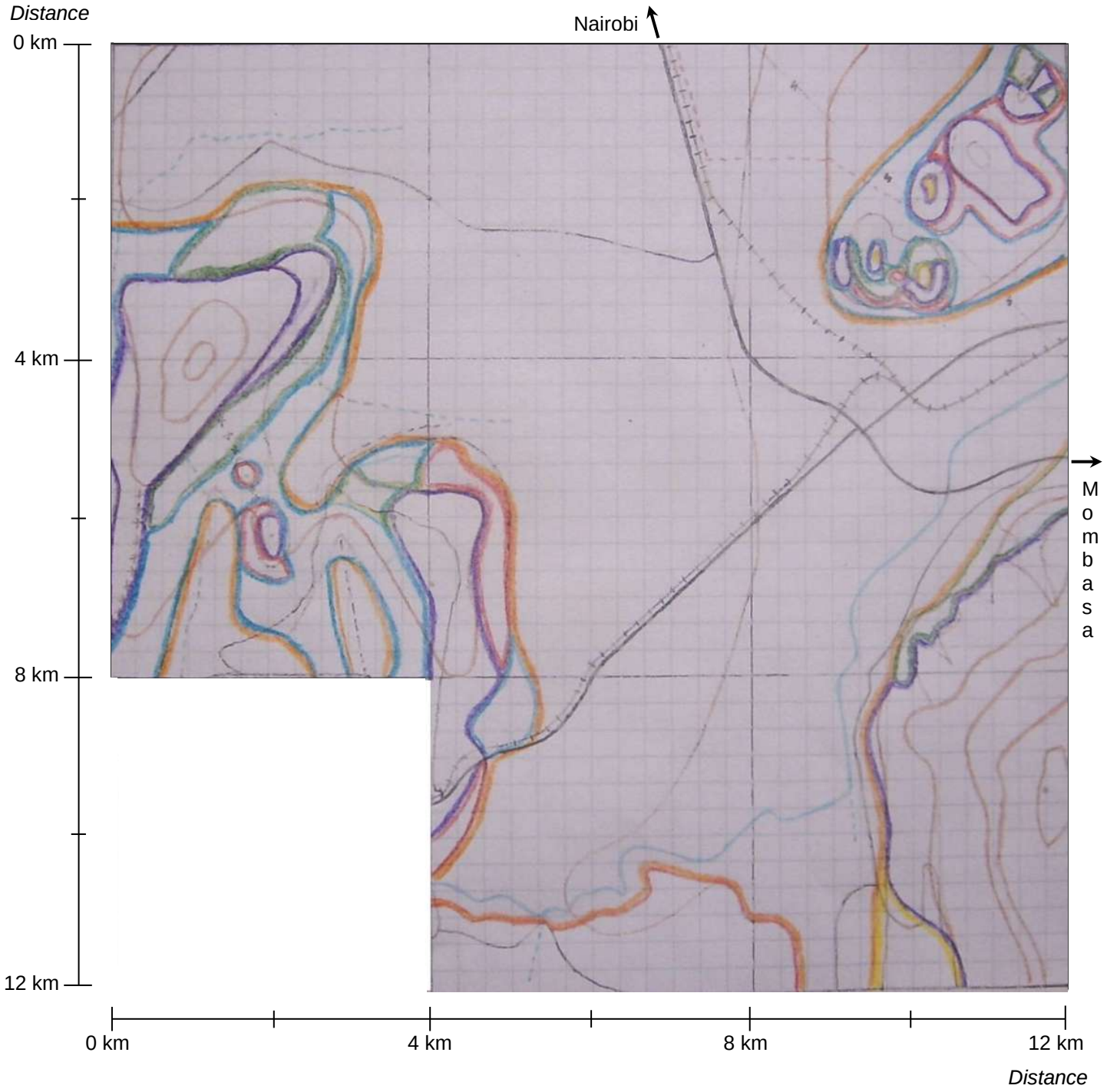
Land use map of research area



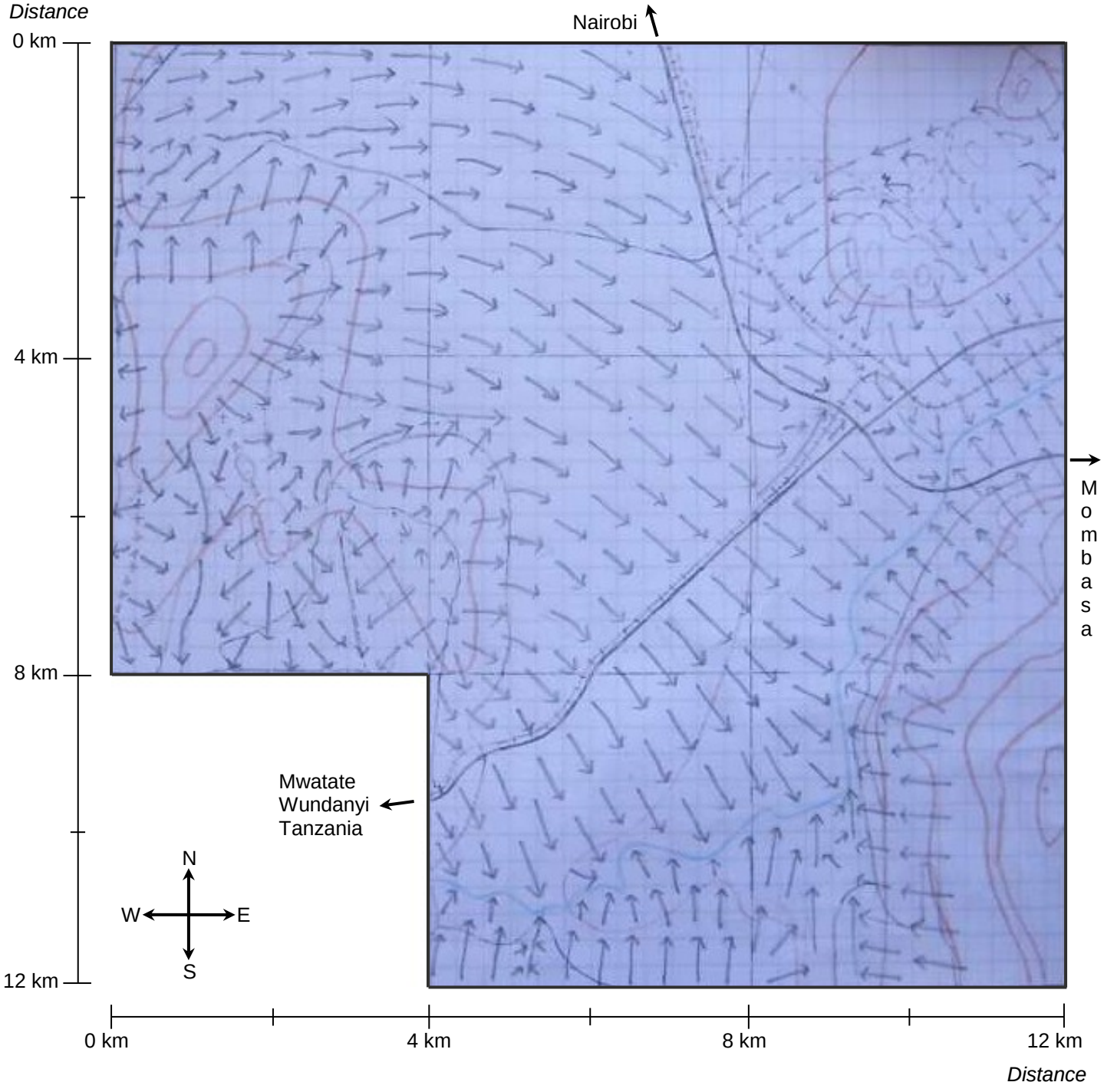
Slopes map of research area



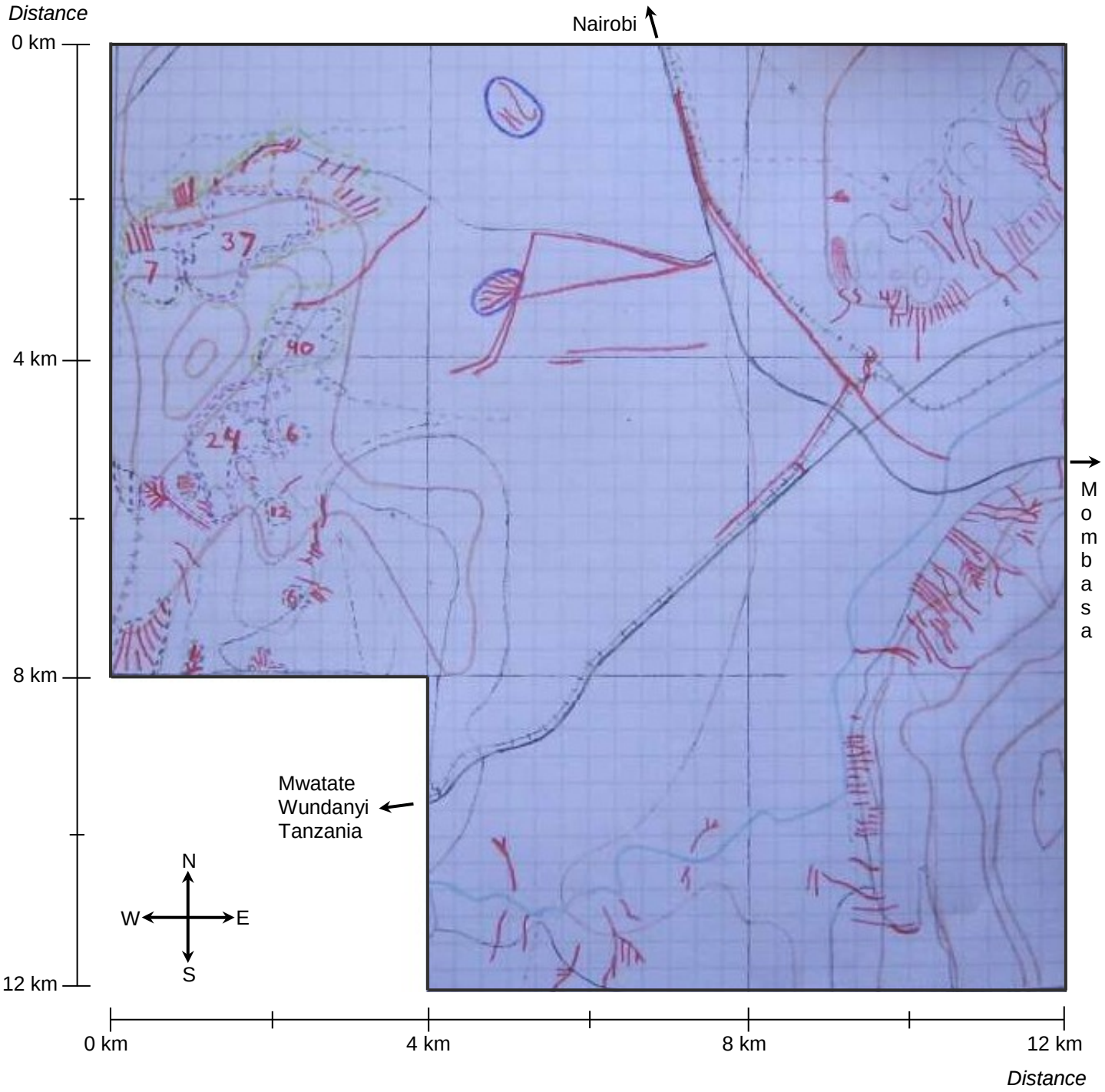
Land classification map of research area



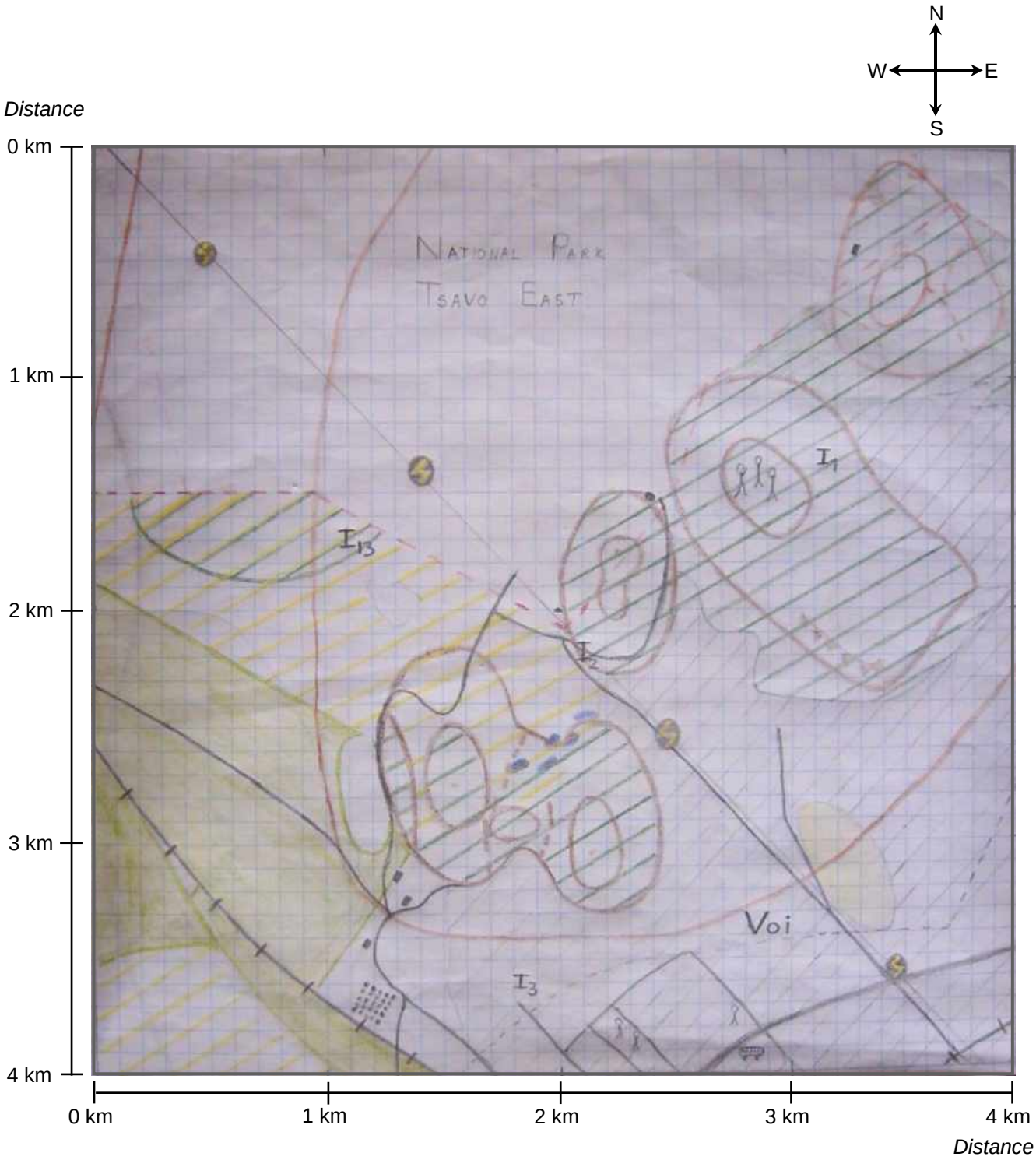
Water flow directions in the research area



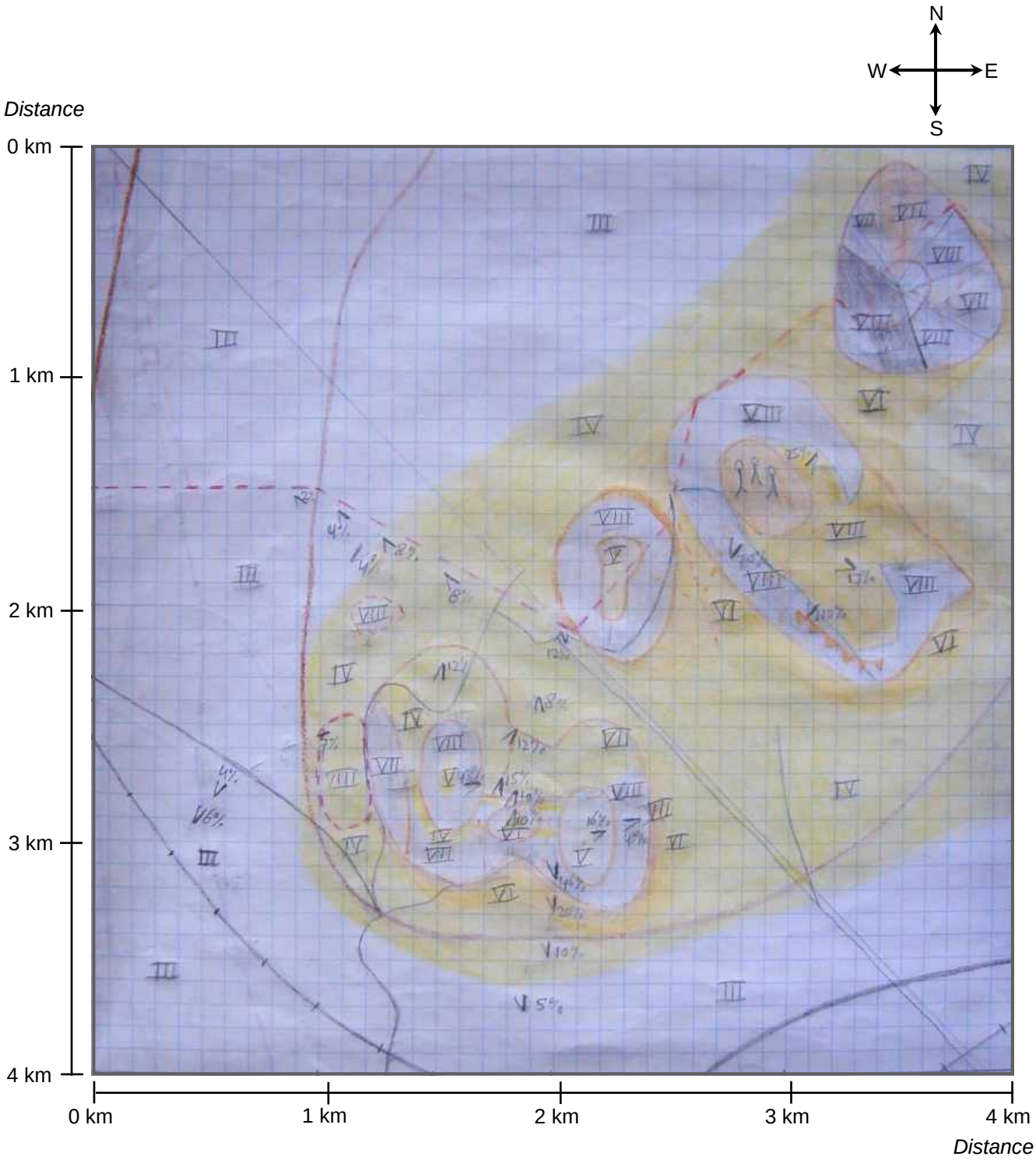
Gully map of research area



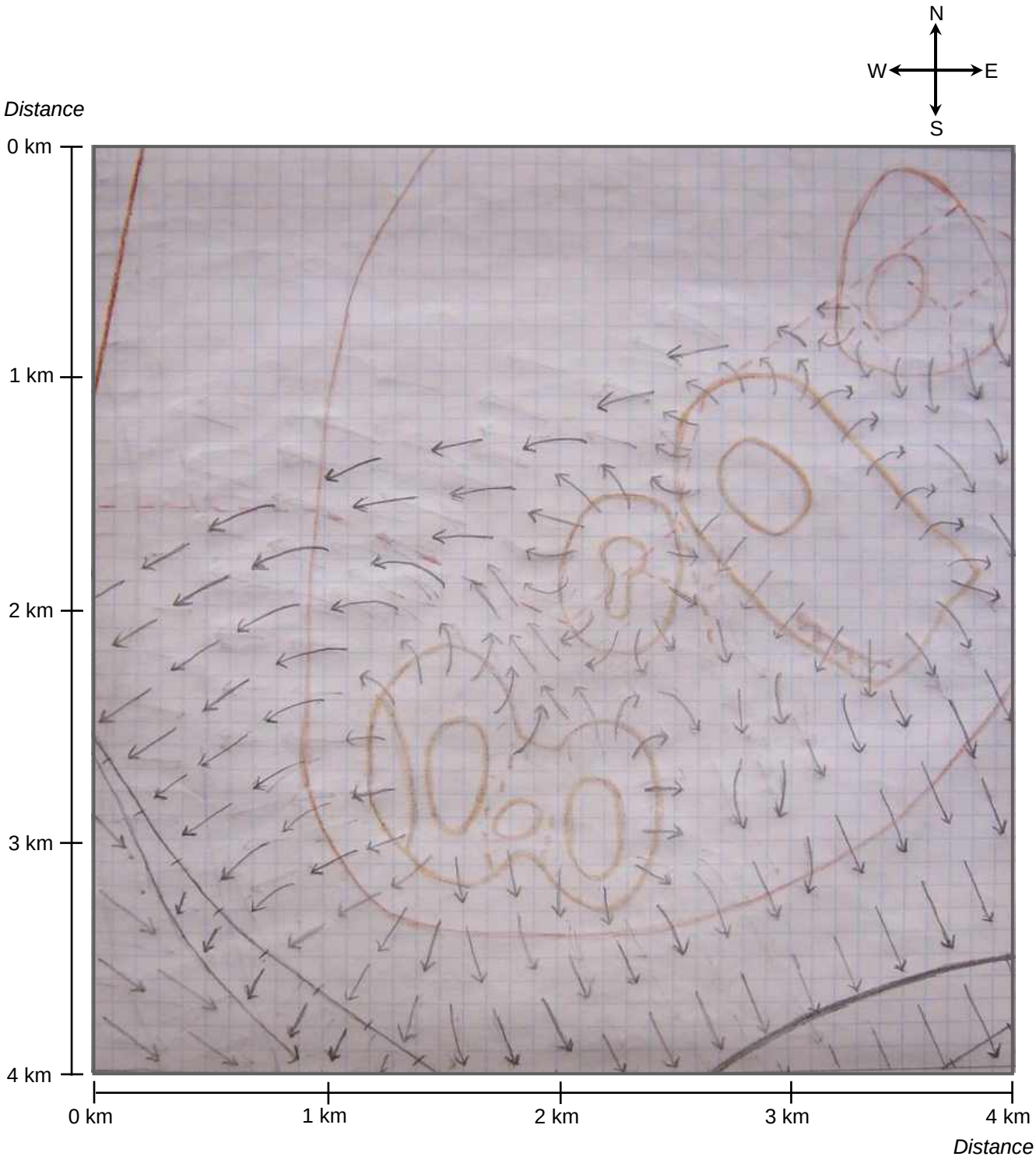
Map 1 A Land use



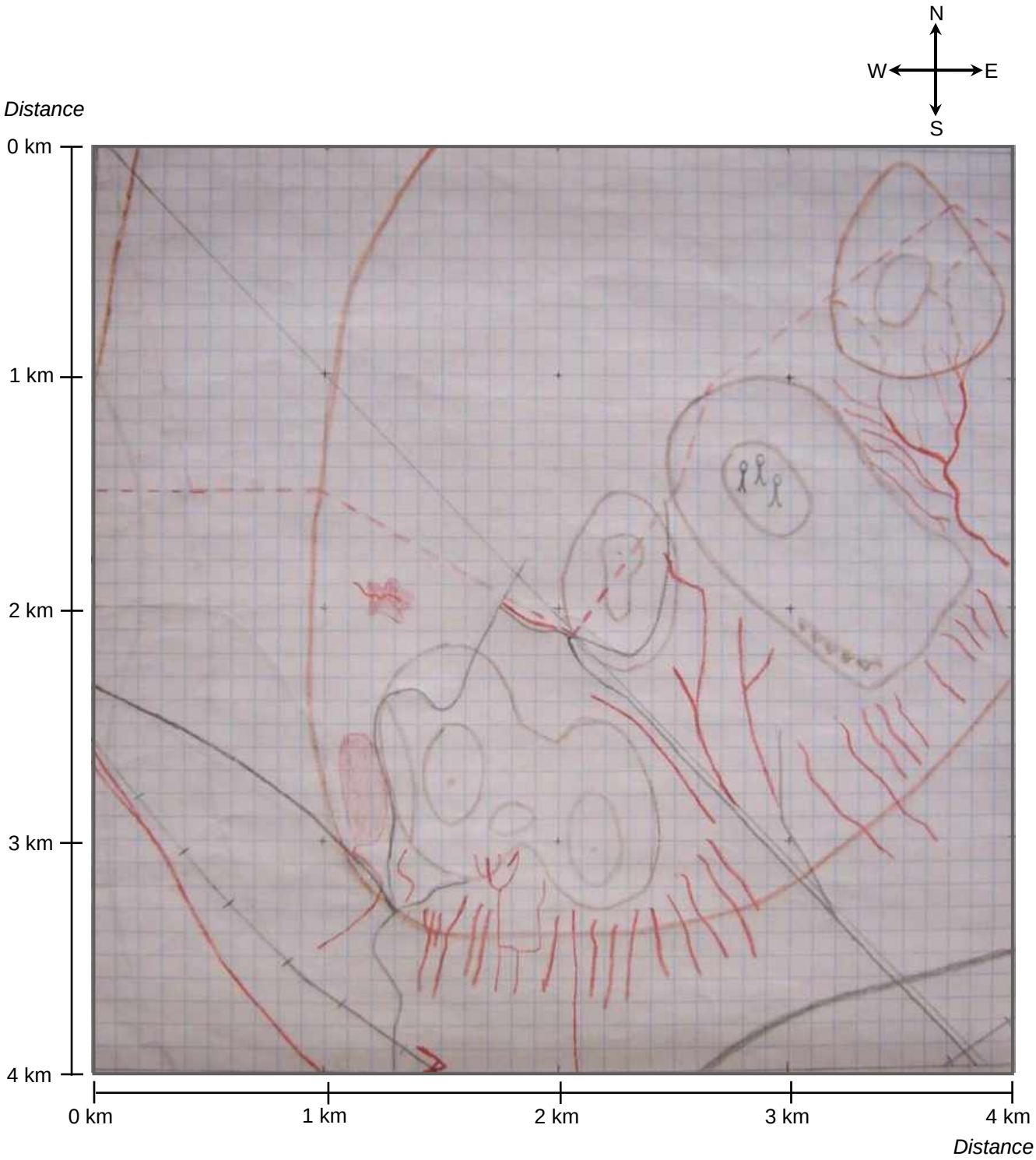
Map 1 B Slope and land capability classification



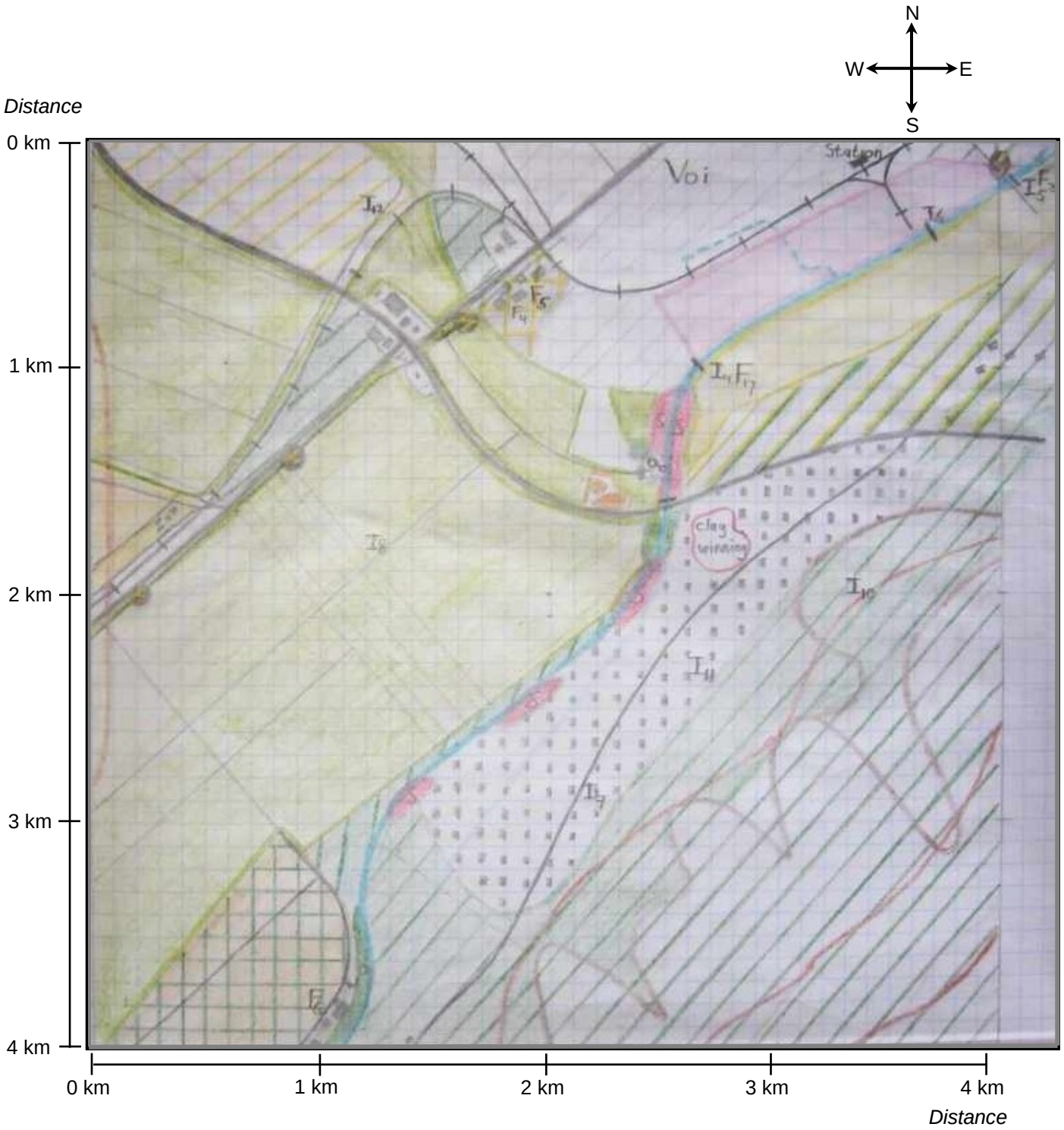
Map 1 C Water flows



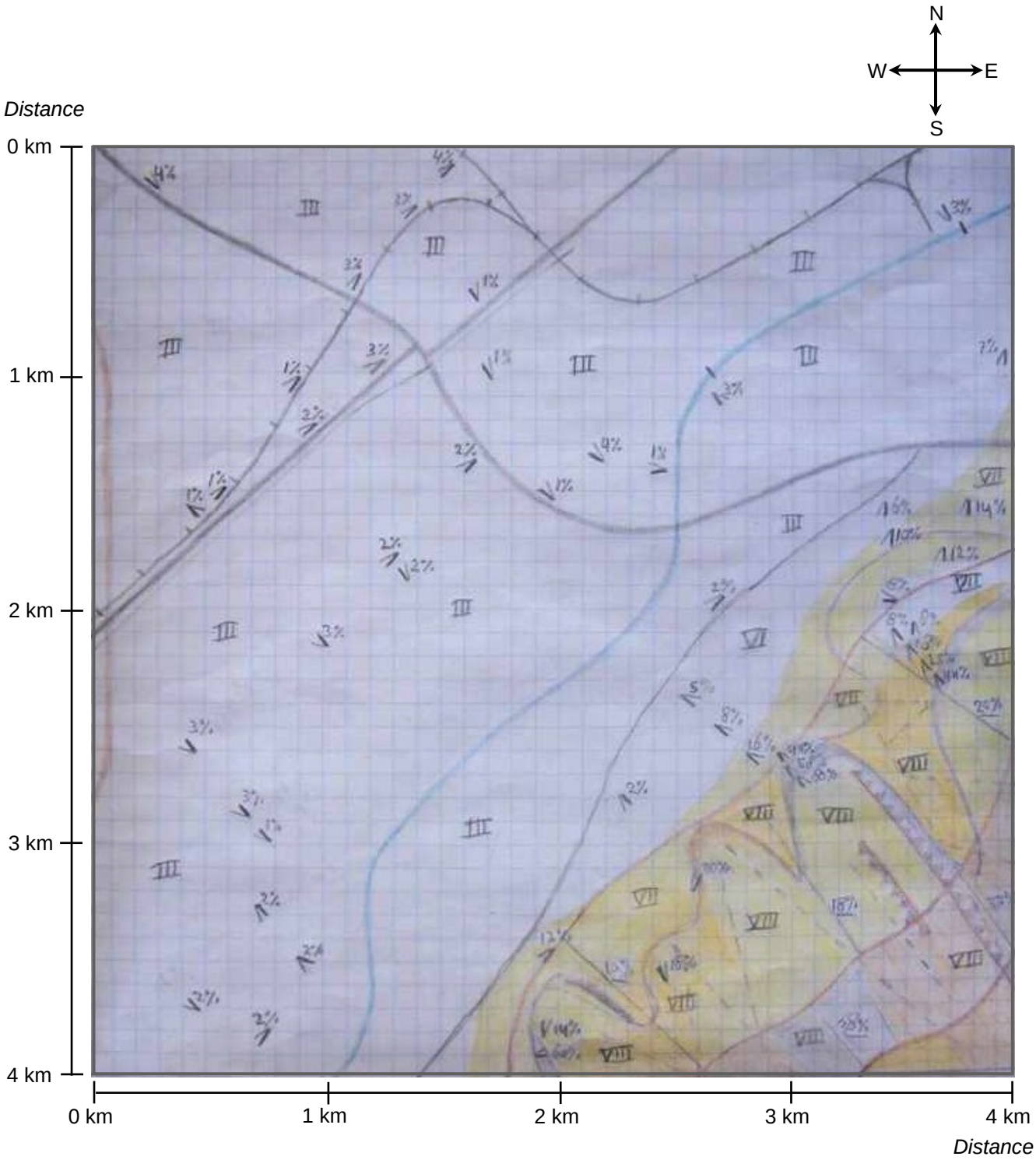
Map 1 D Gullies



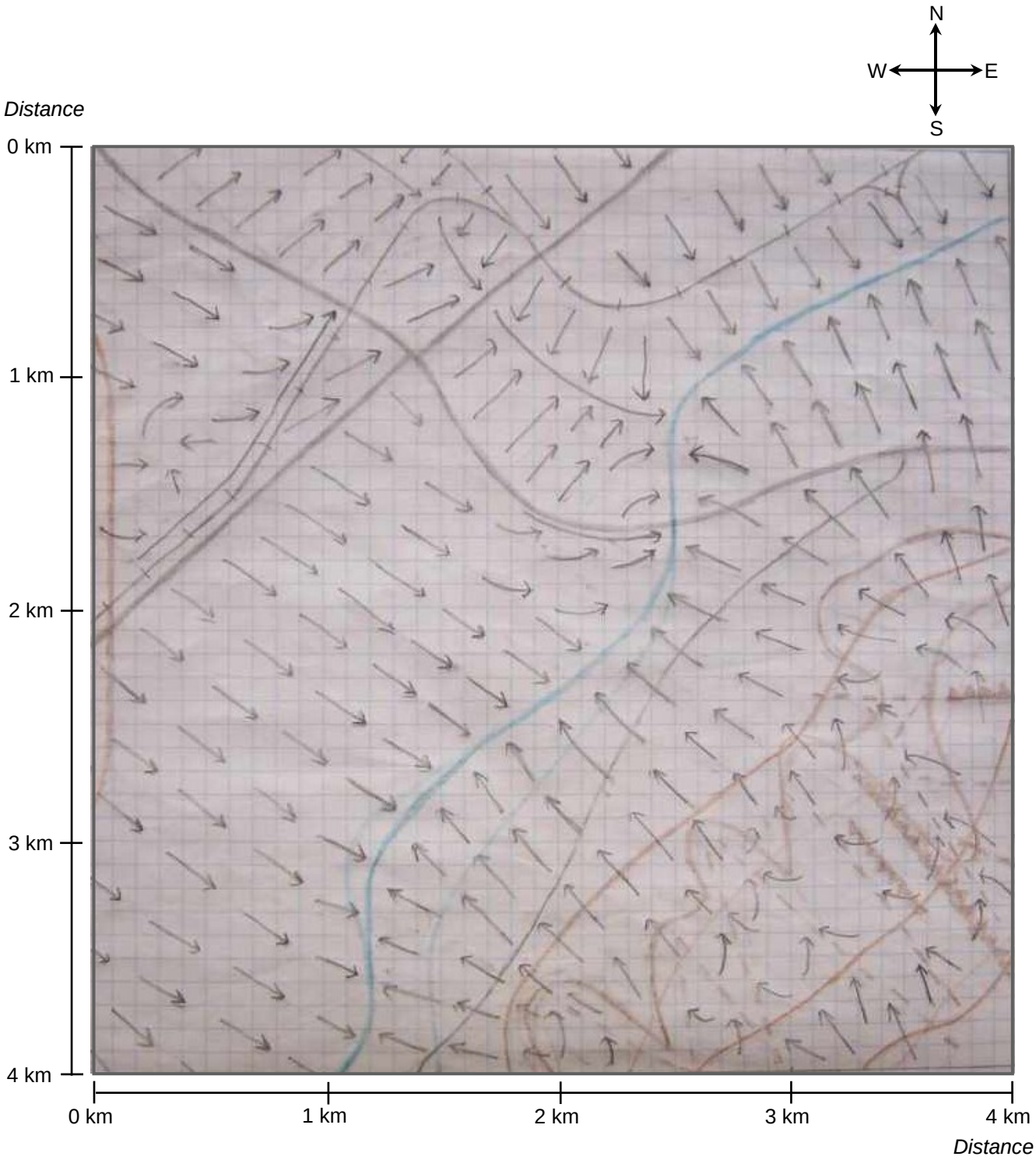
Map 2 A Land use



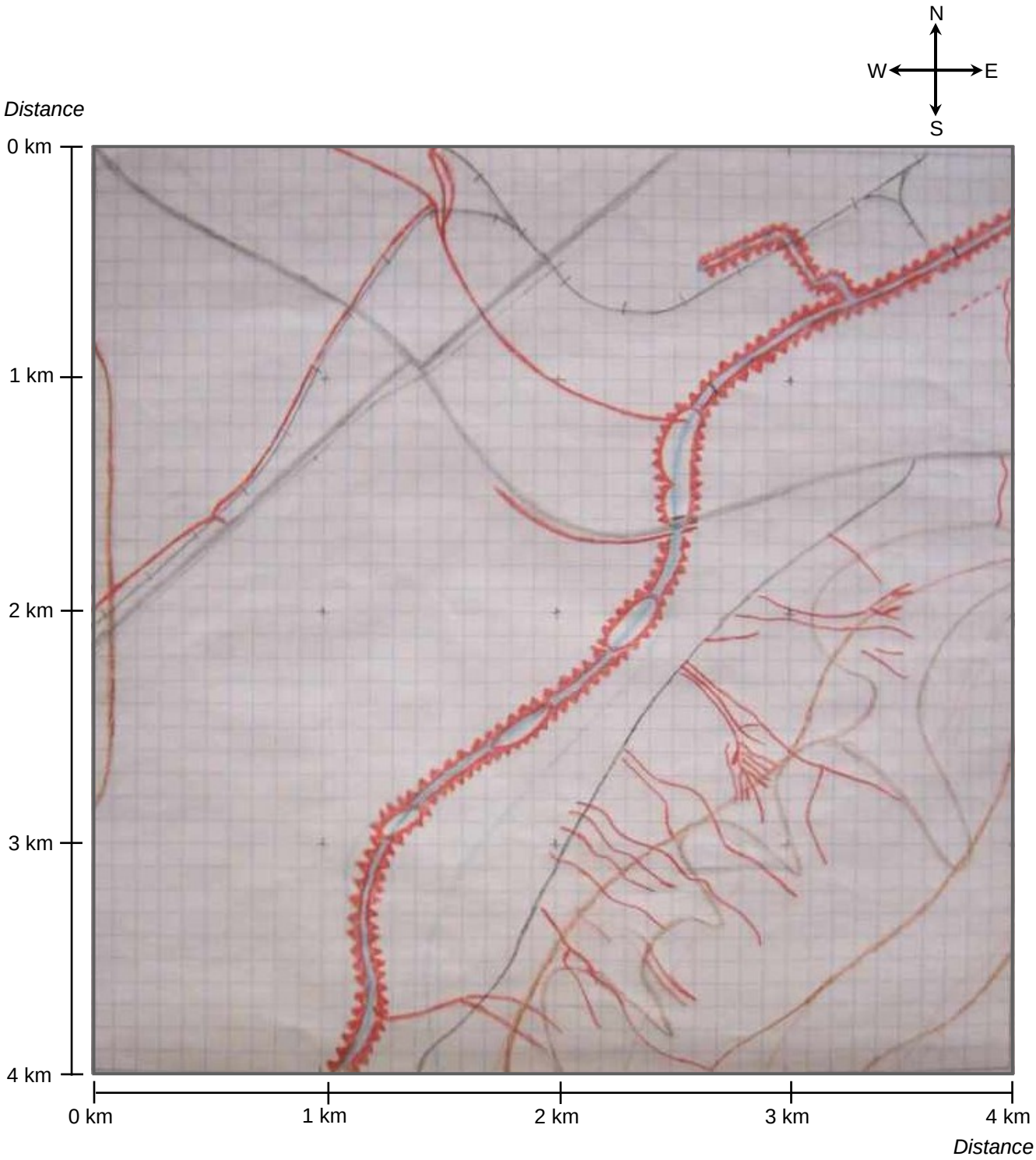
Map 2 B Slope and land capability classification



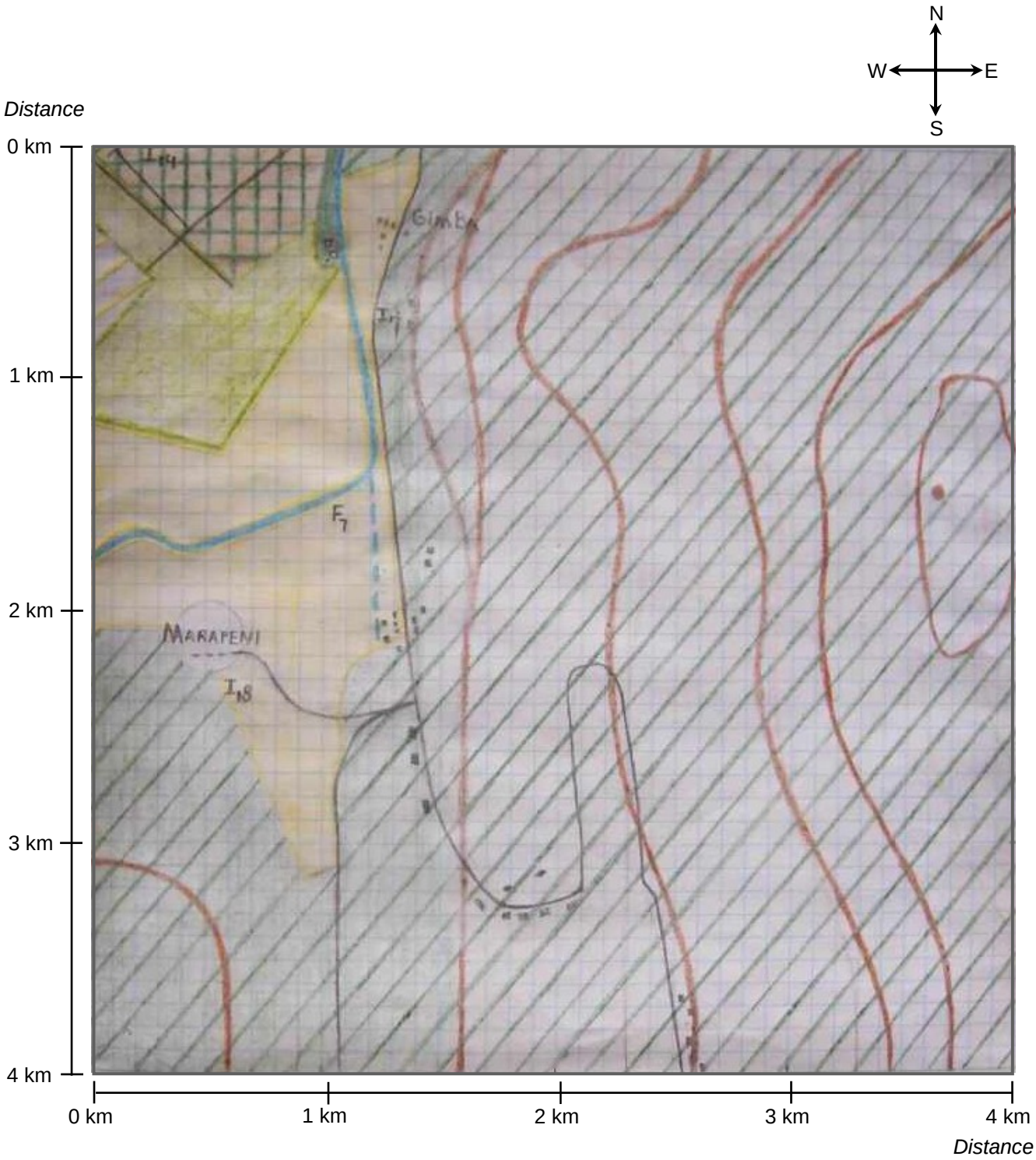
Map 2 C Water flows



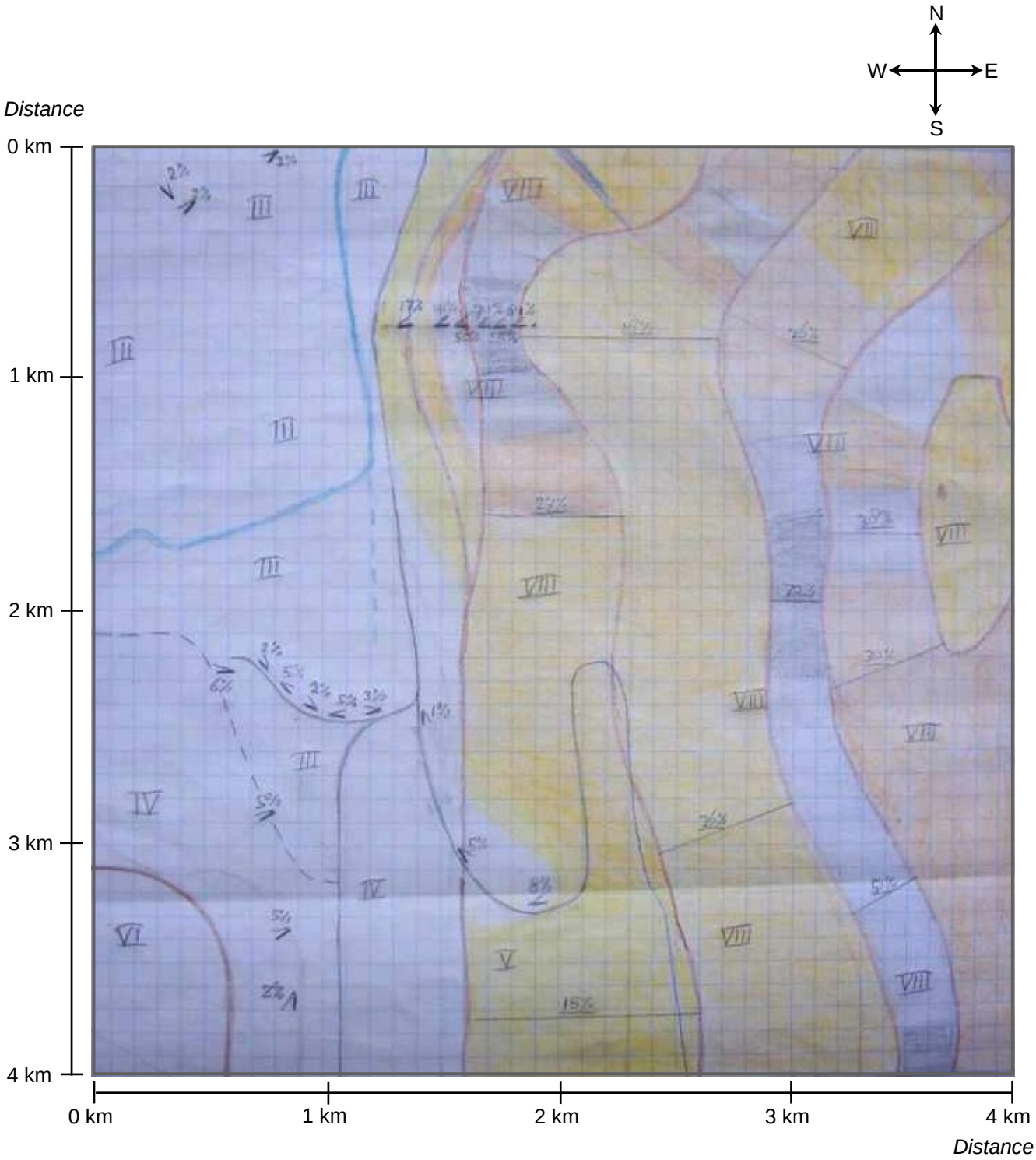
Map 2 D Gullies



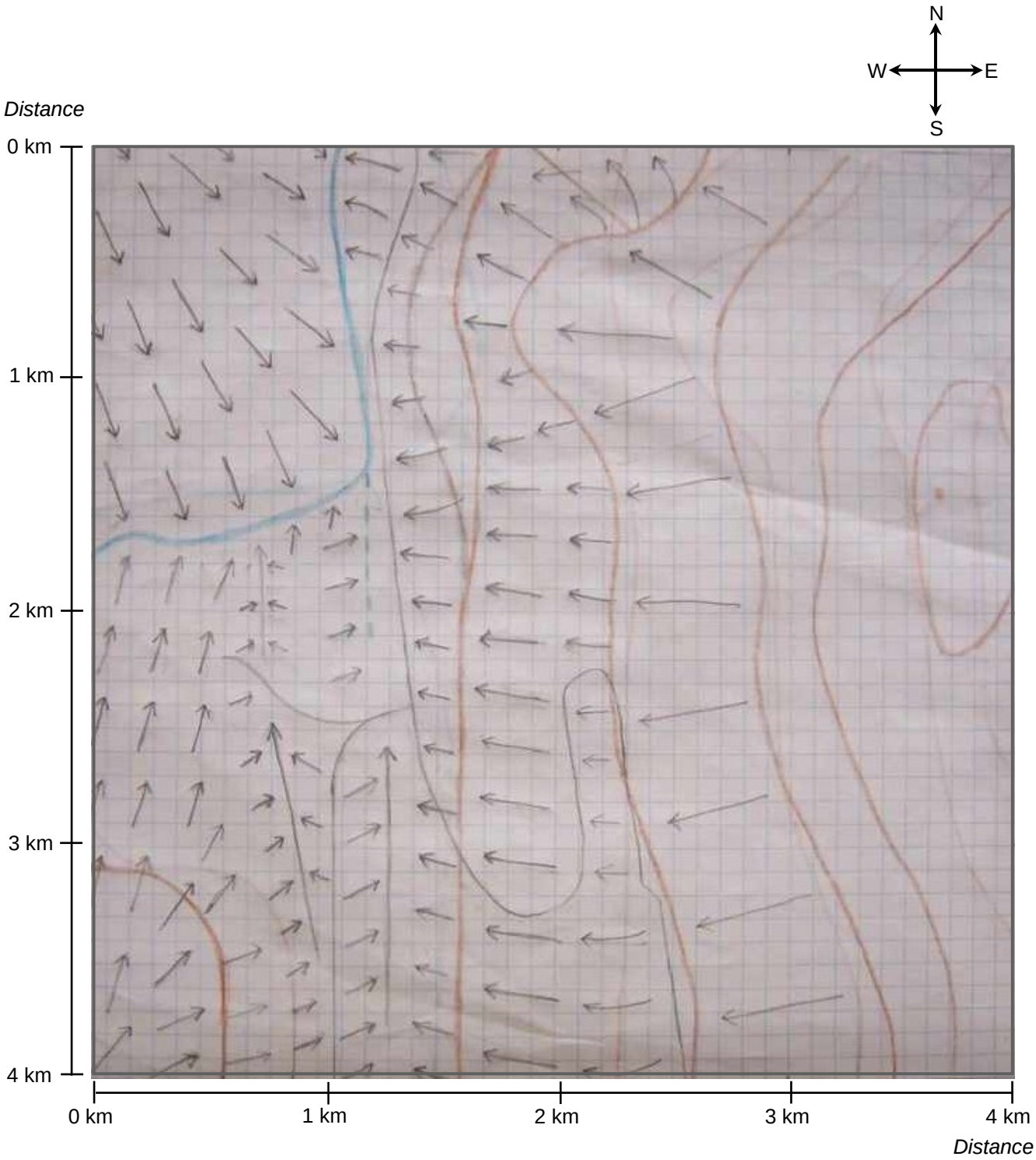
Map 3 A Land use



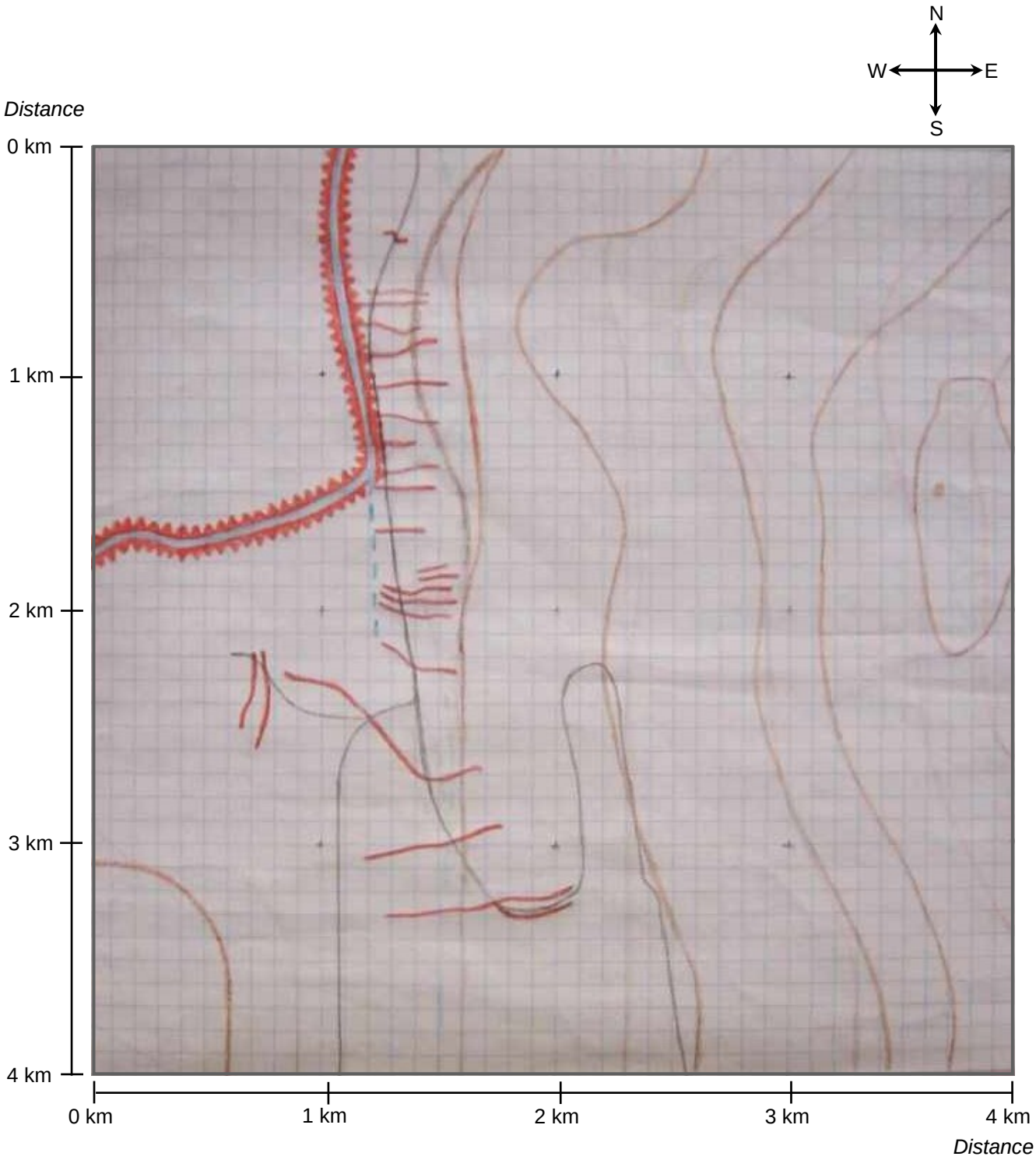
Map 3 B Slope and land capability classification



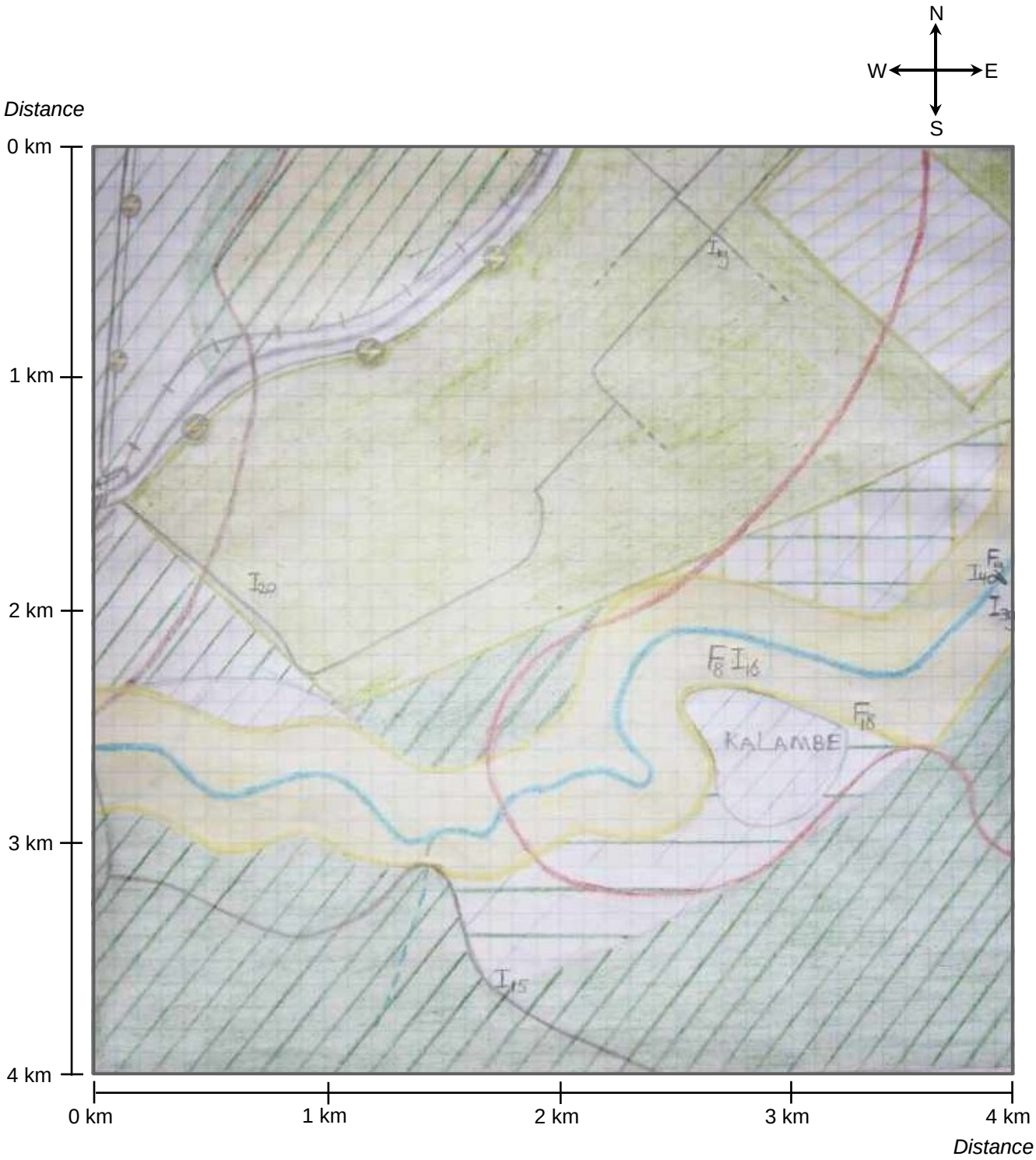
Map 3 C Water flows



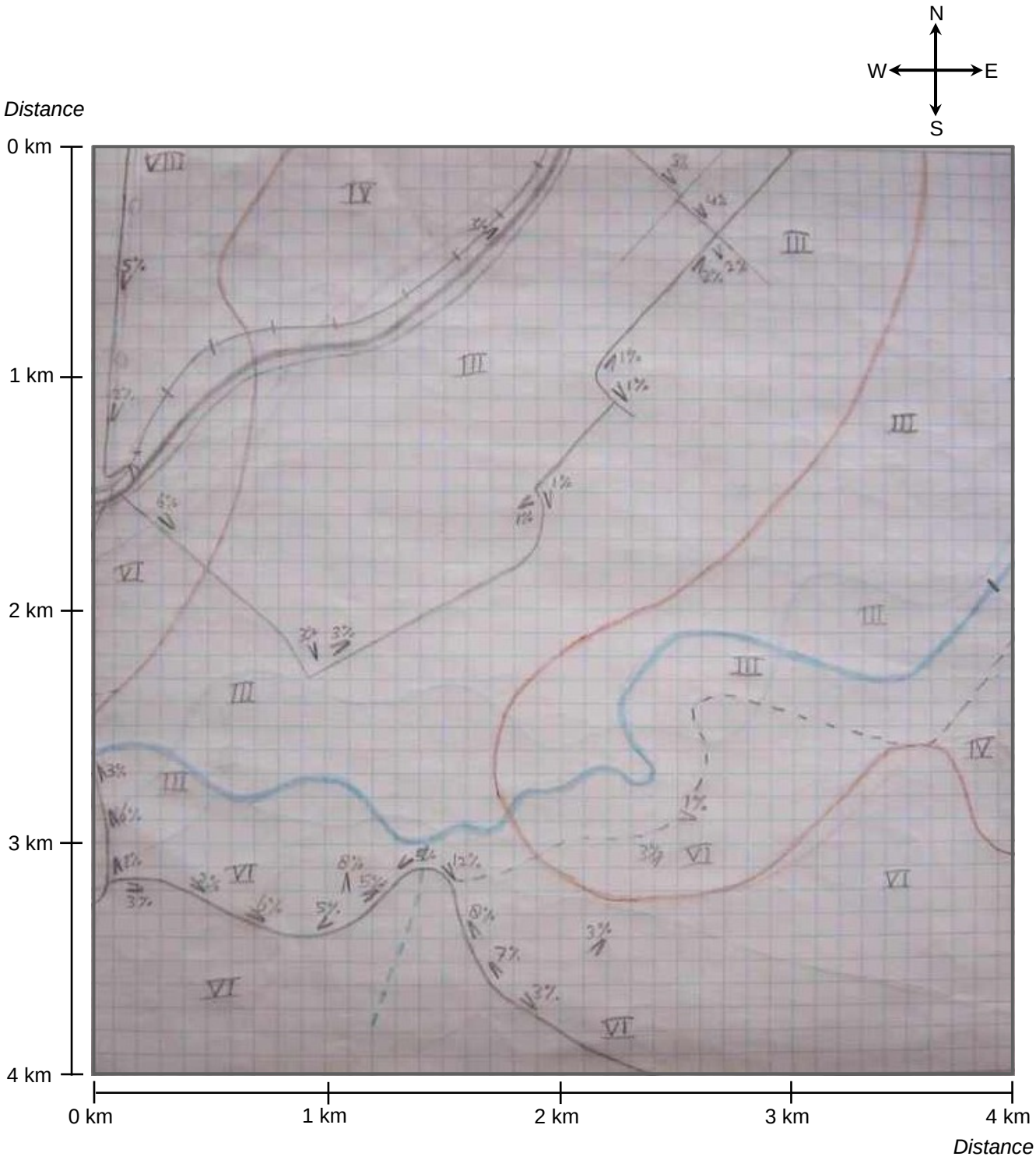
Map 3 D Gullies



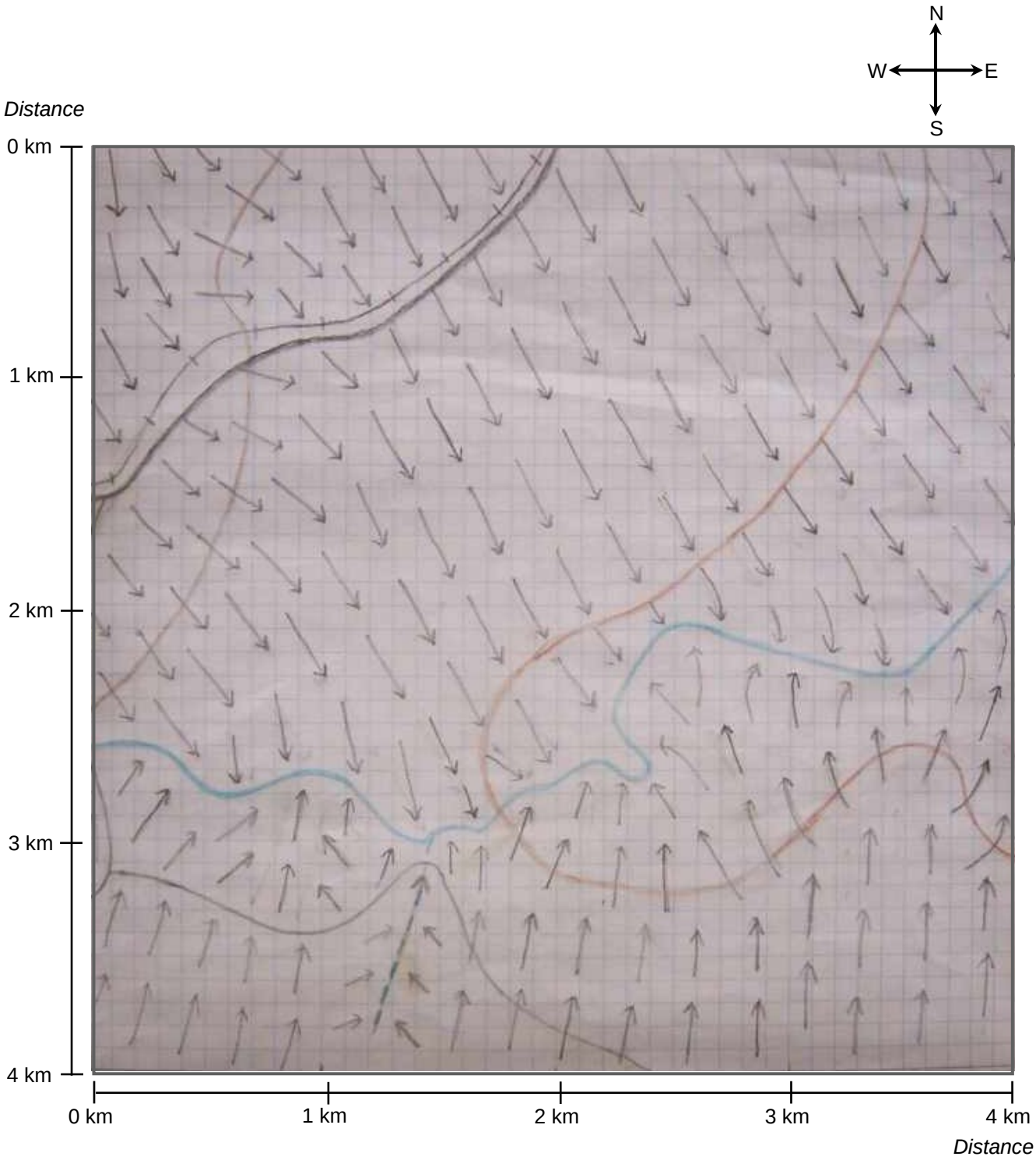
Map 4 A Land use



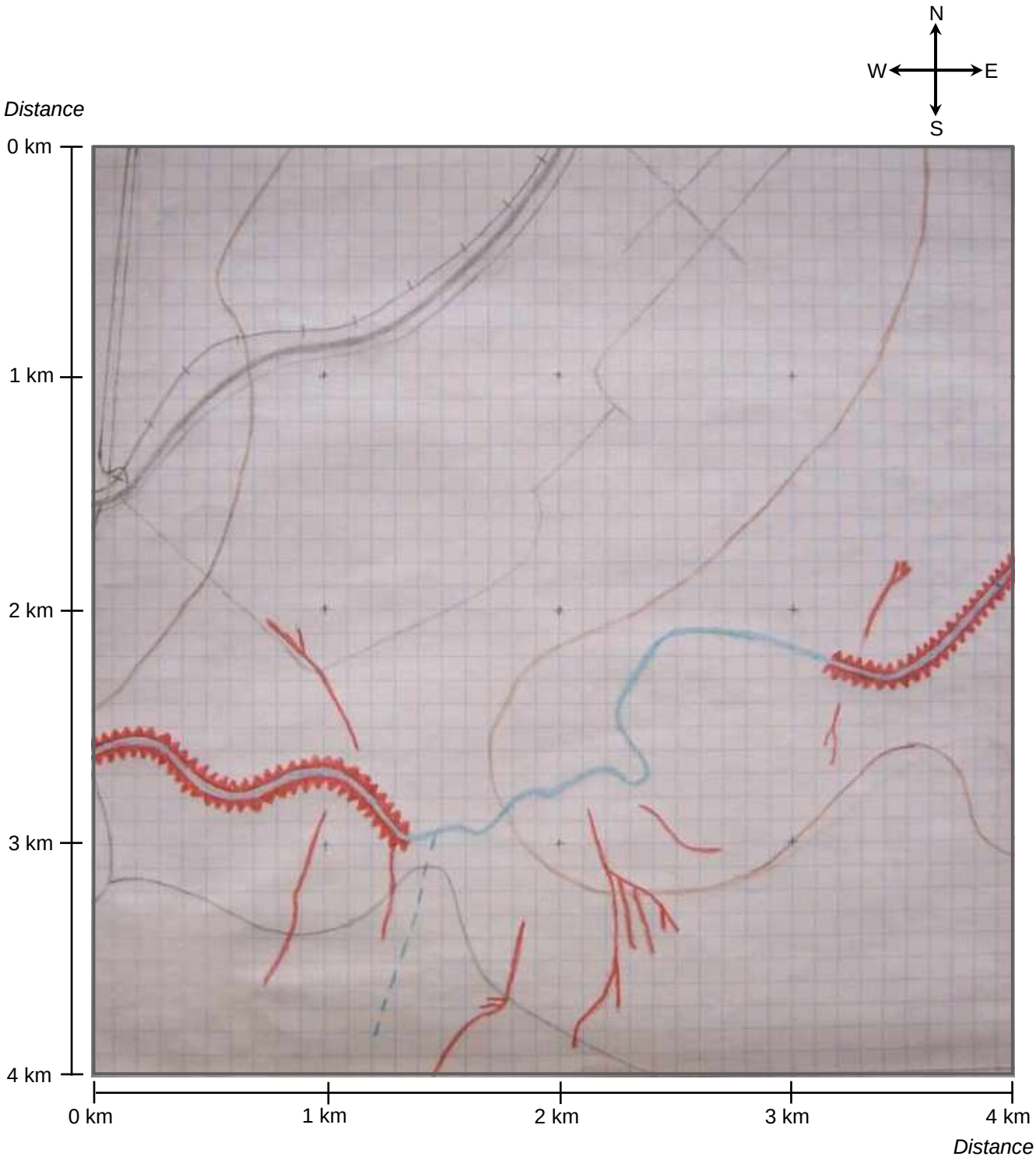
Map 4 B Slope and land capability classification



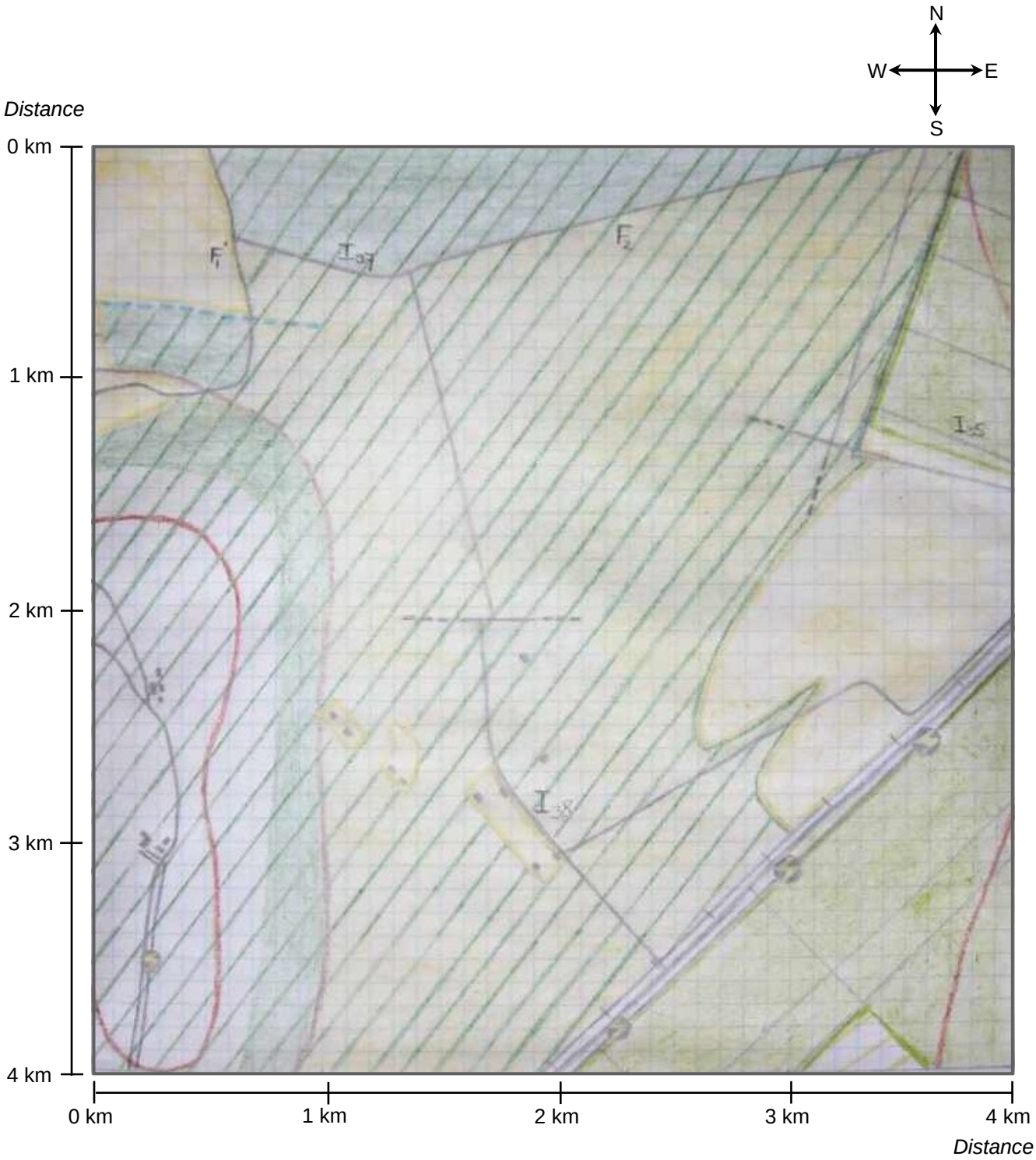
Map 4 C Water flows



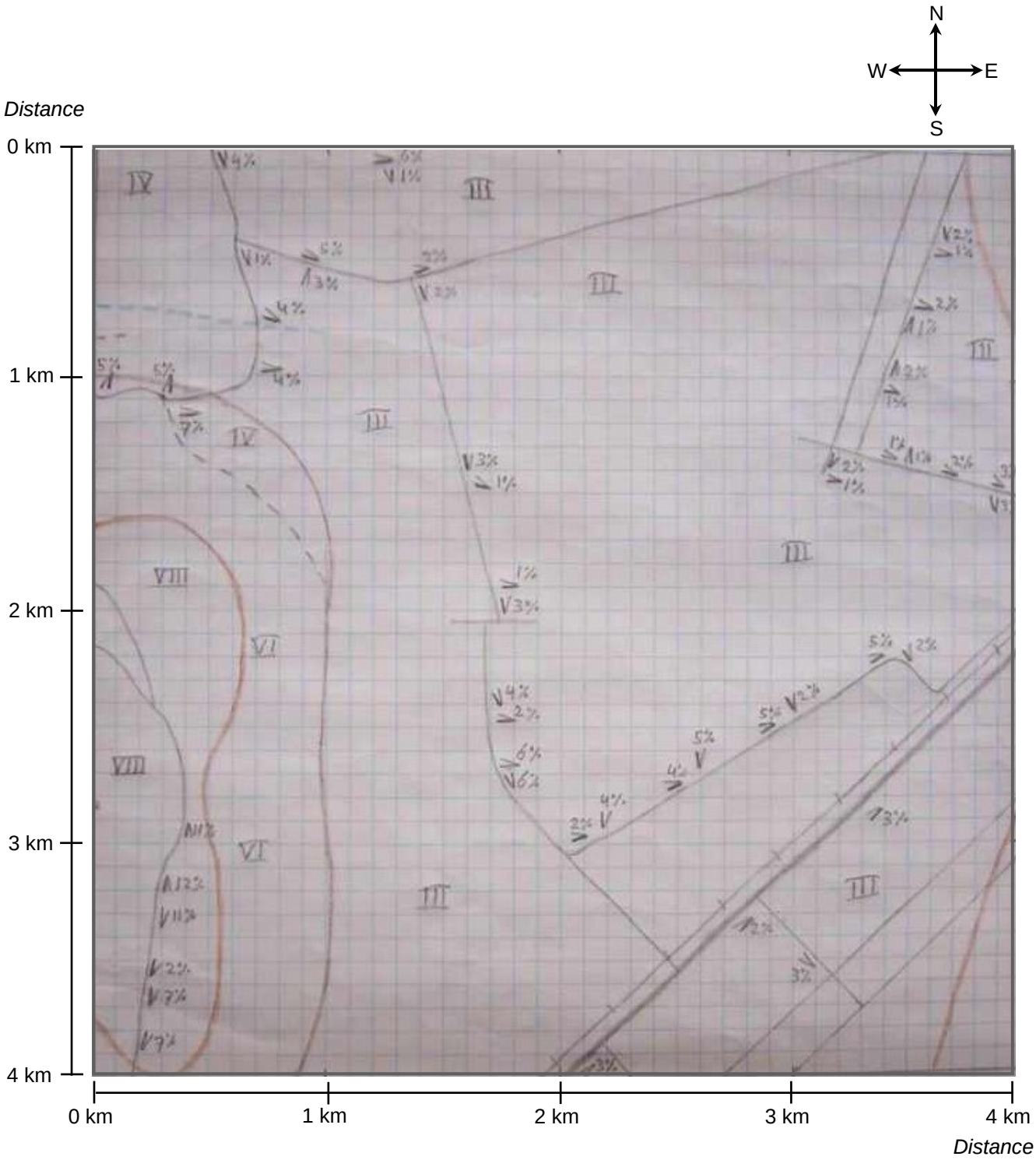
Map 4 D Gullies



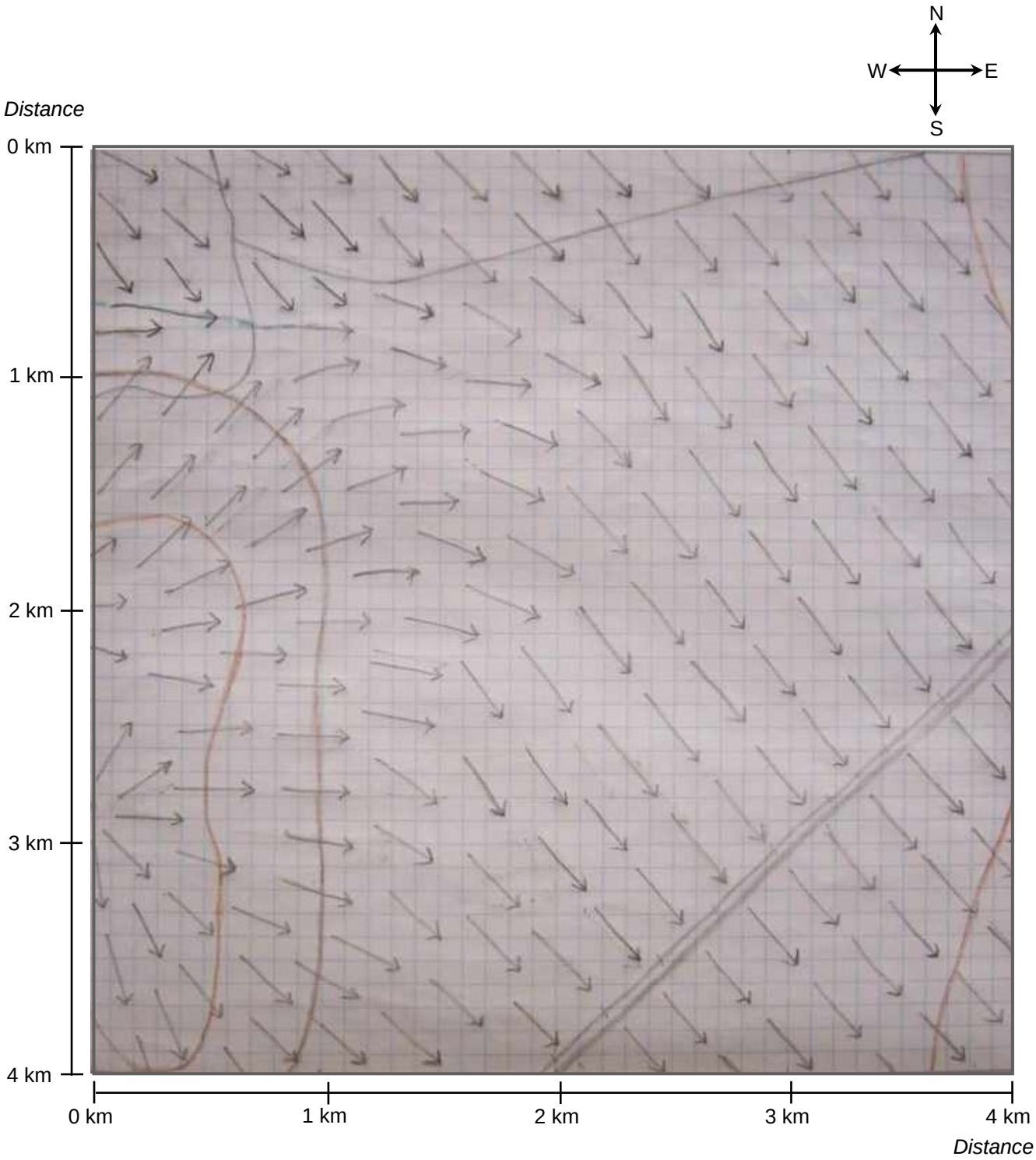
Map 5 A Land use



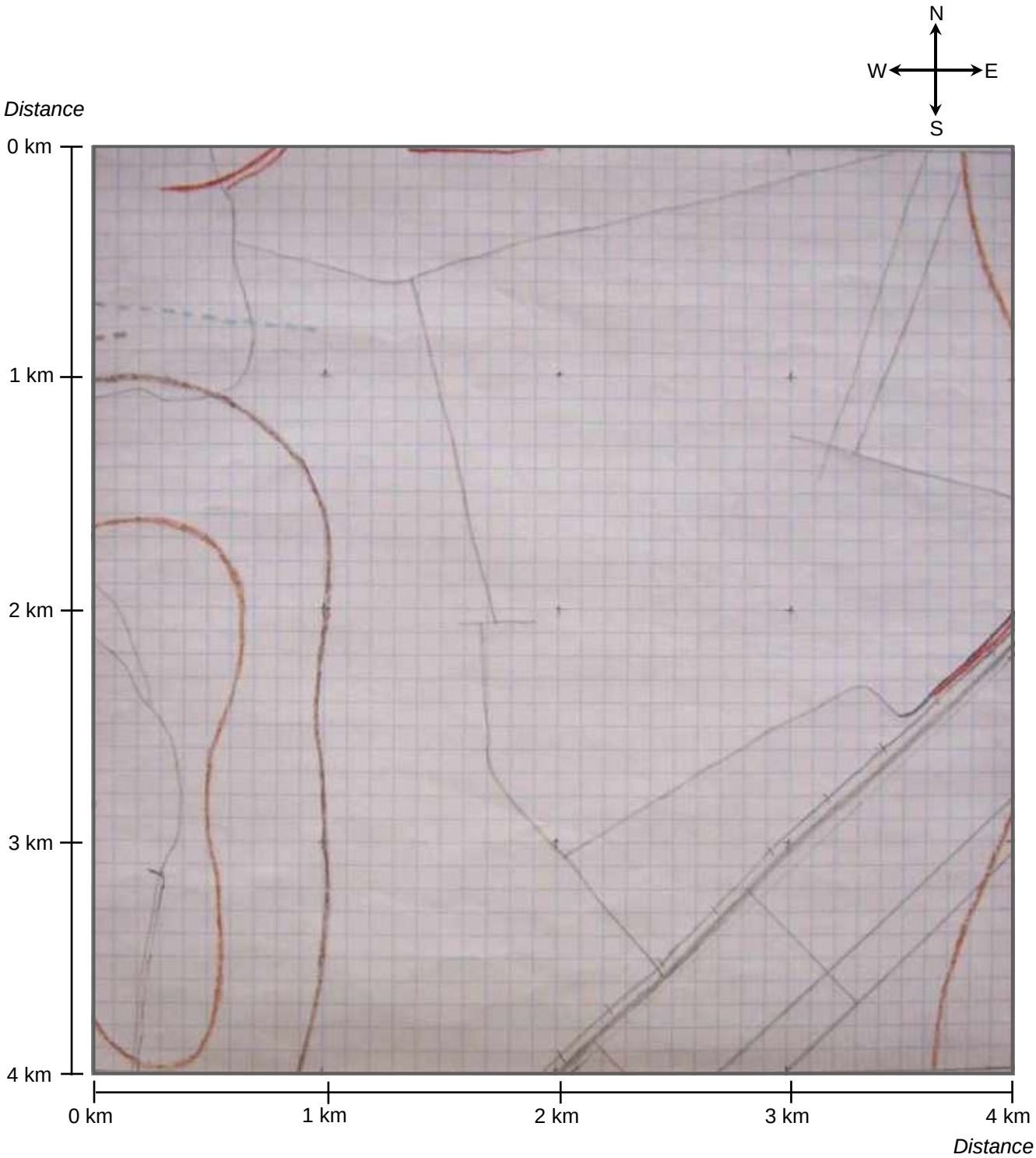
Map 5 B Slope and land capability classification



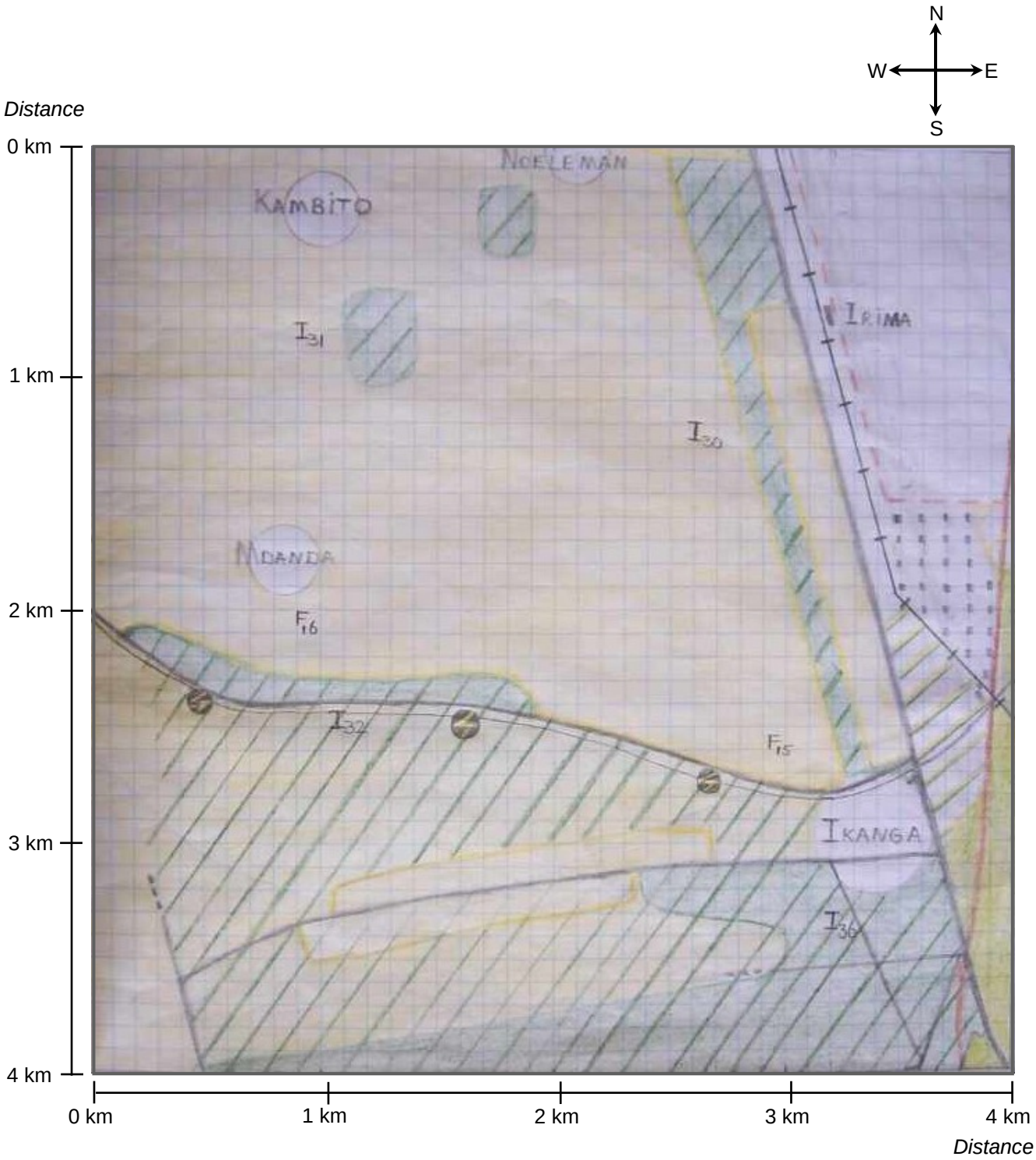
Map 5 C Water flows



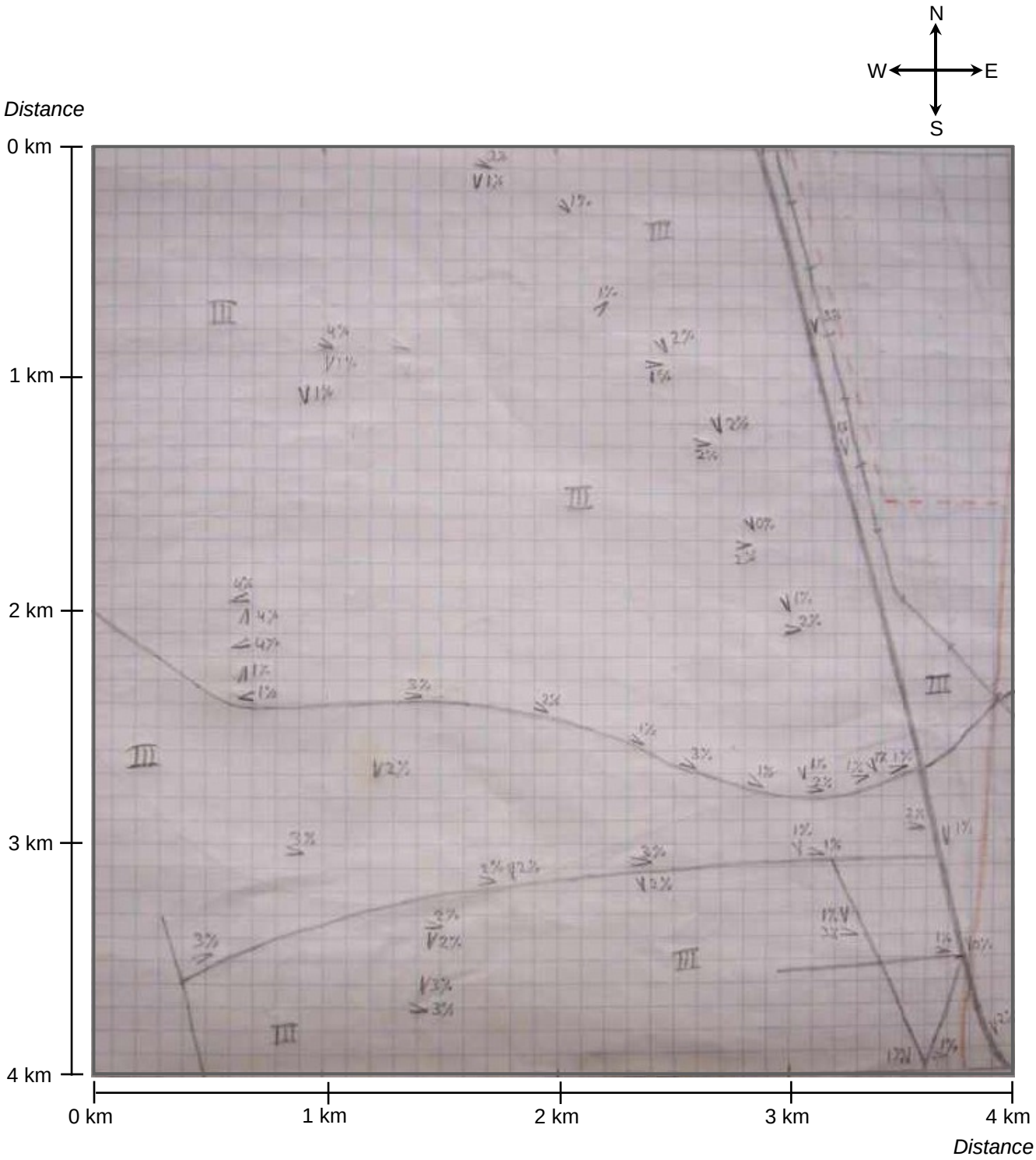
Map 5 D Gullies



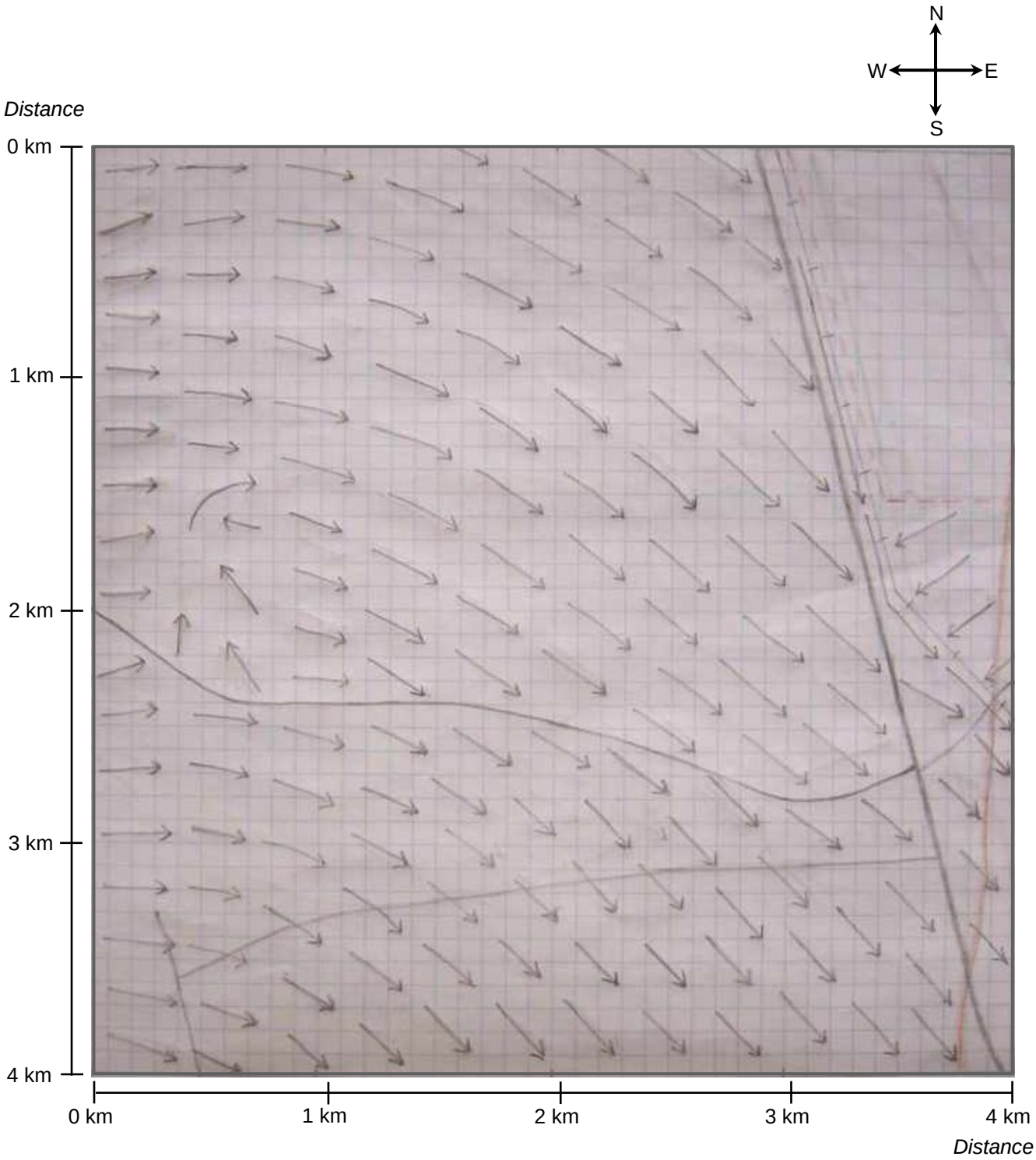
Map 6 A Land use



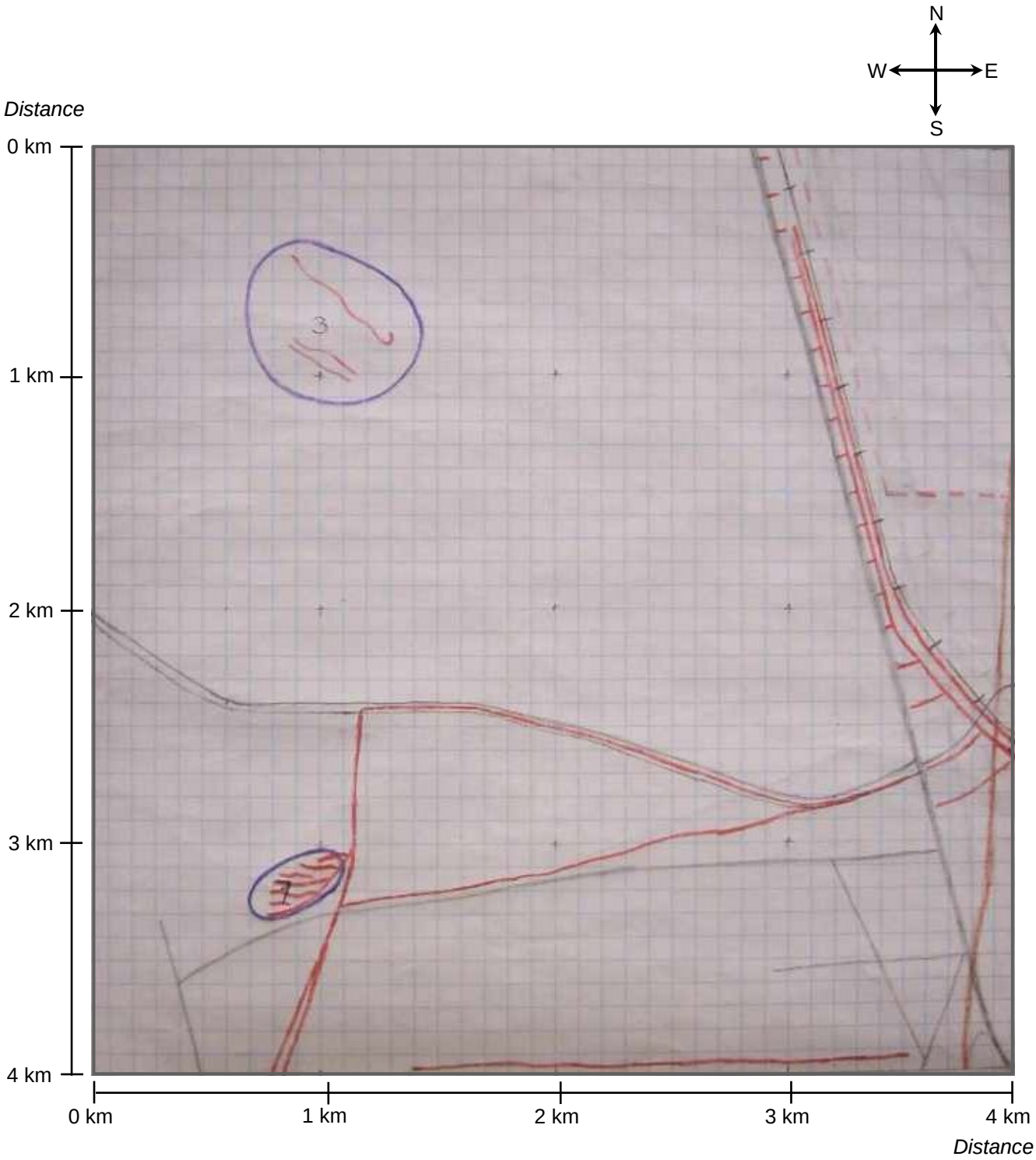
Map 6 B Slope and land capability classification



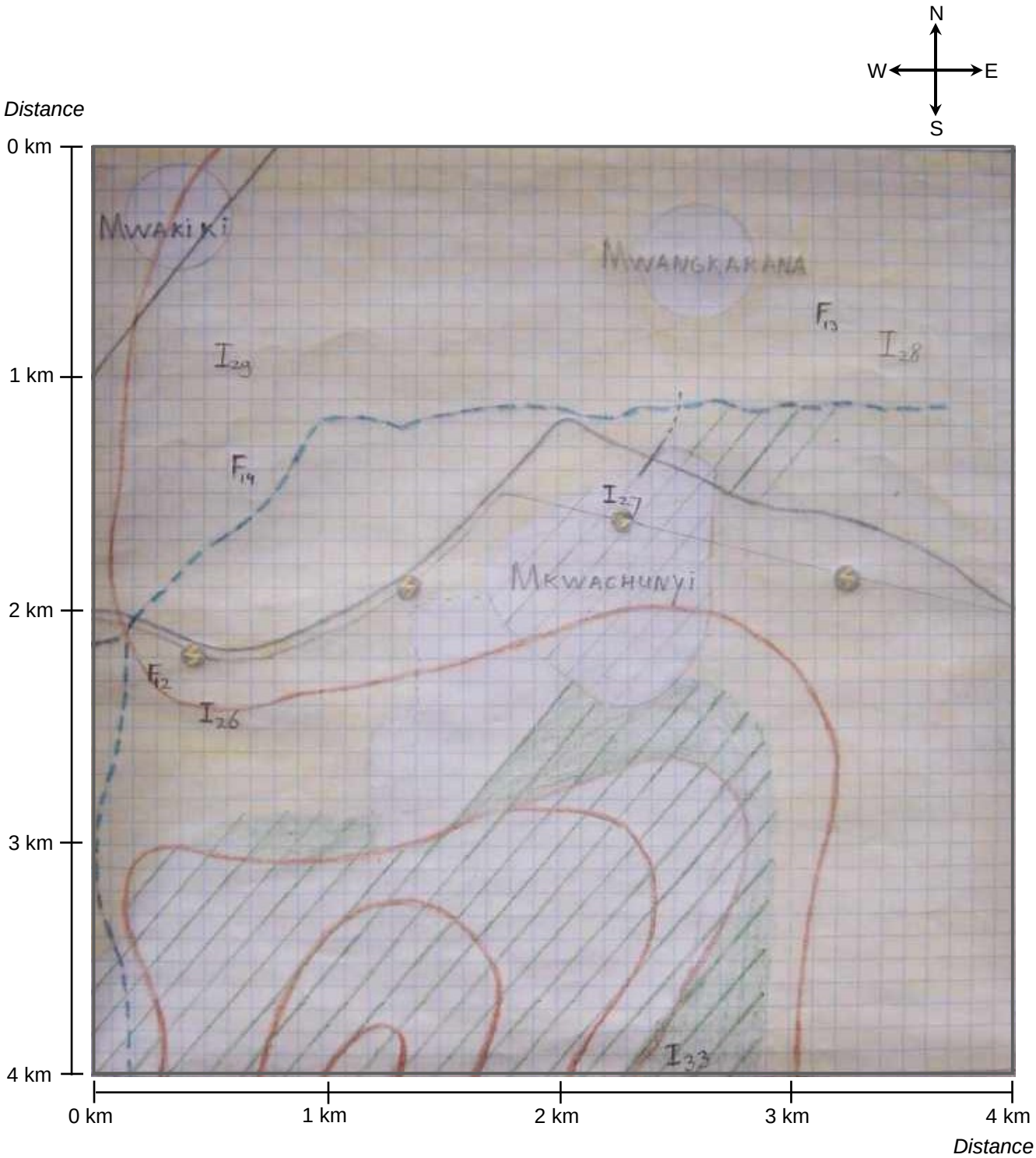
Map 6 C Water flows



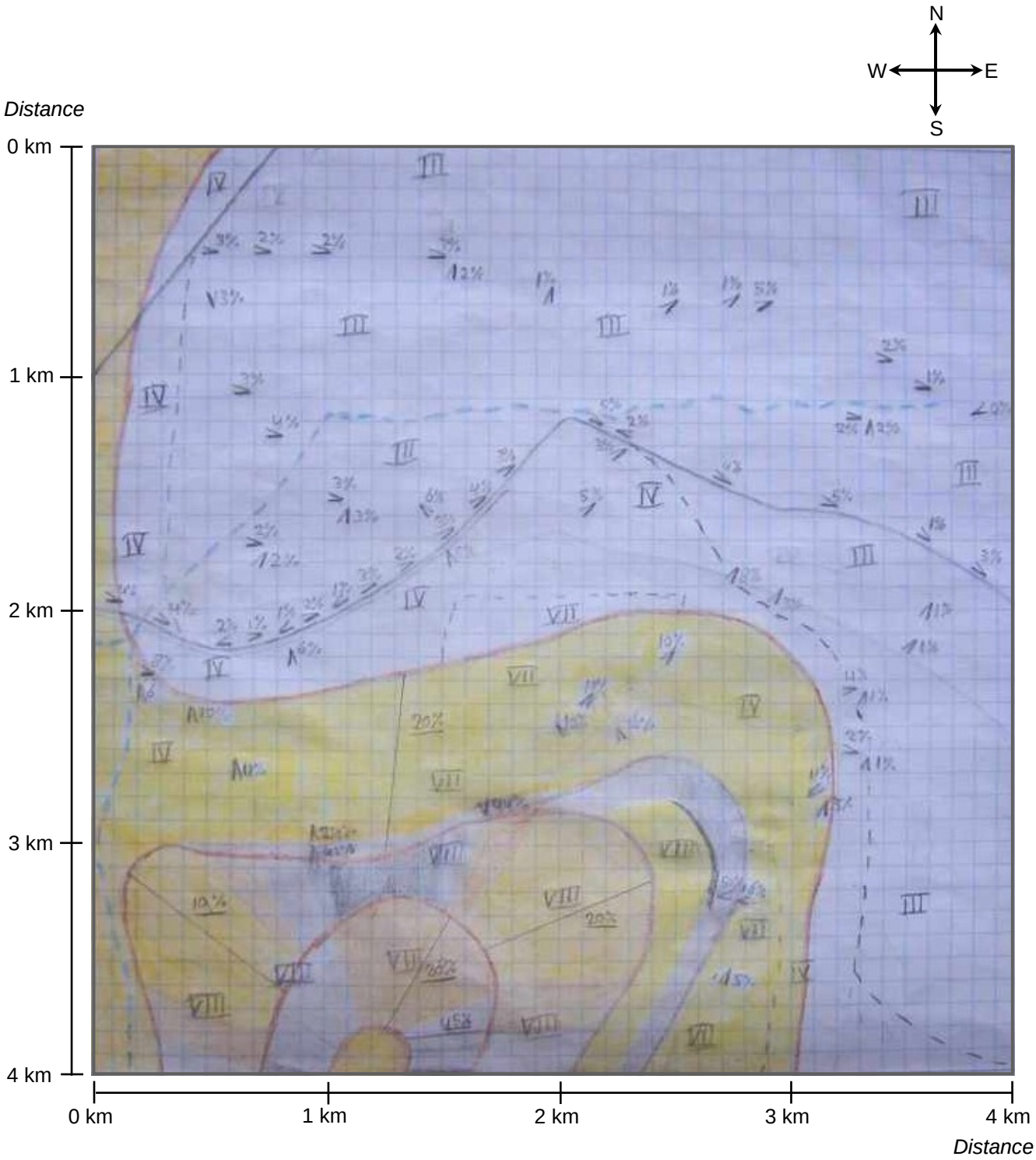
Map 6 D Gullies



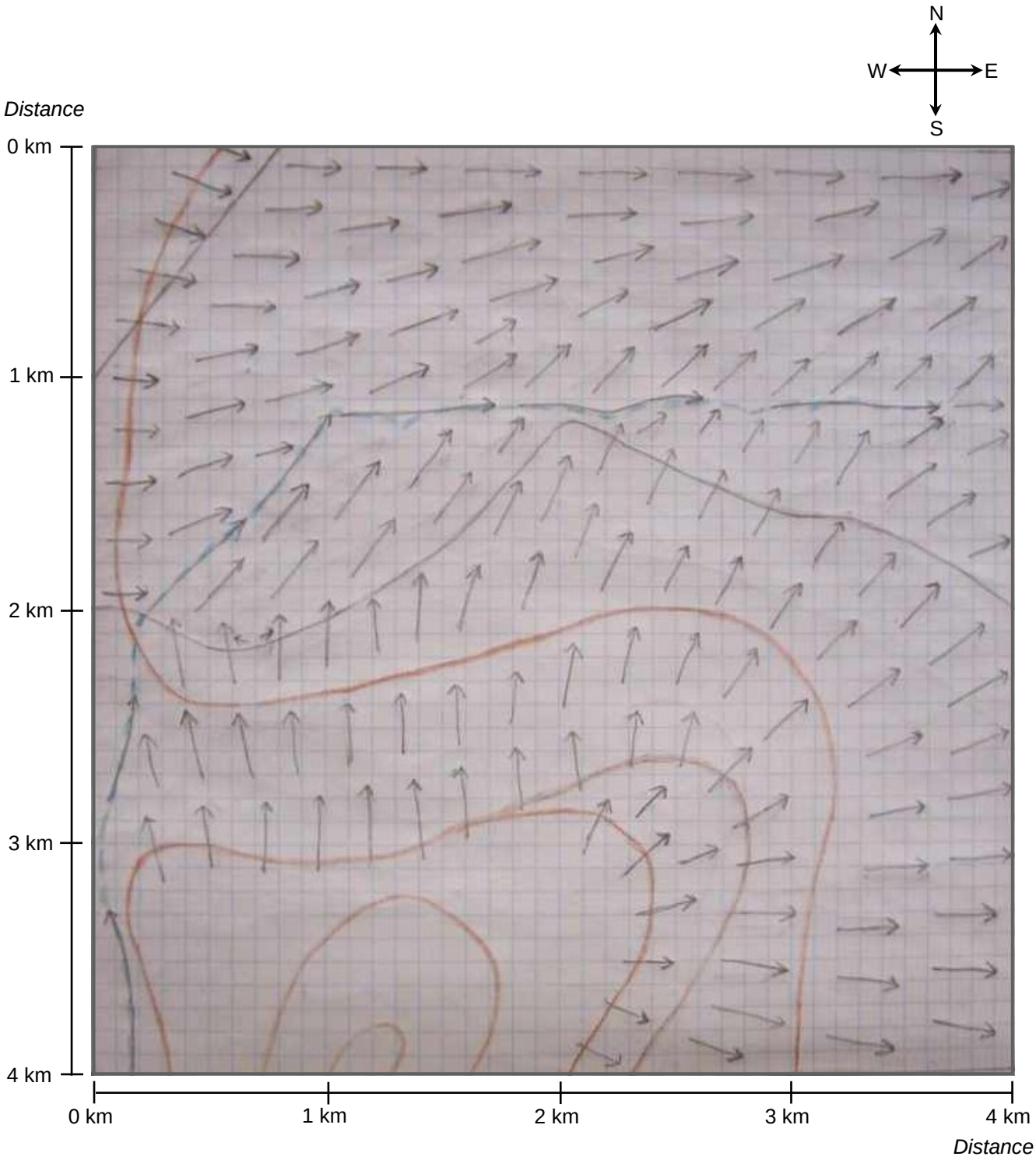
Map 7 A Land use



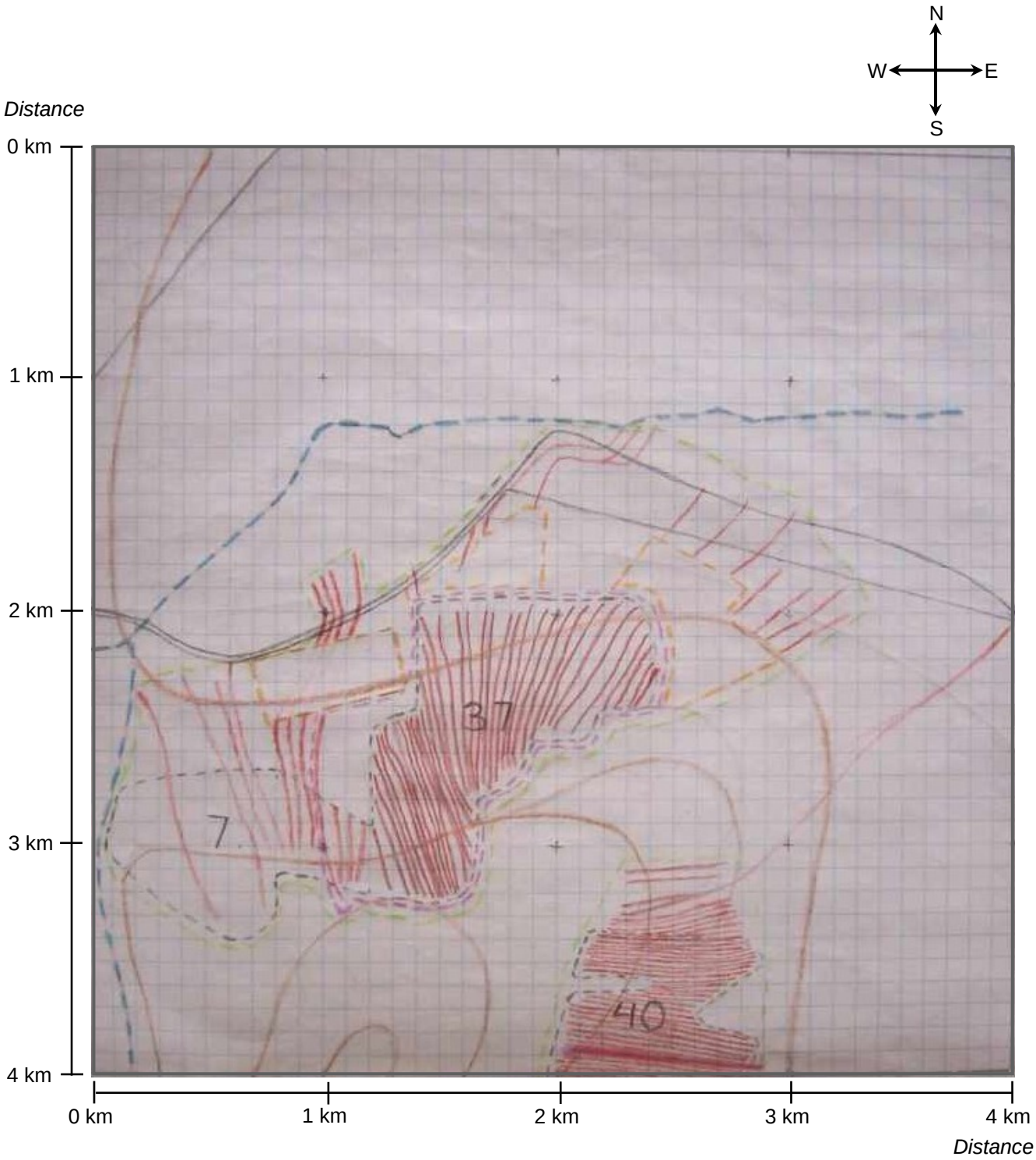
Map 7 B Slope and land capability classification



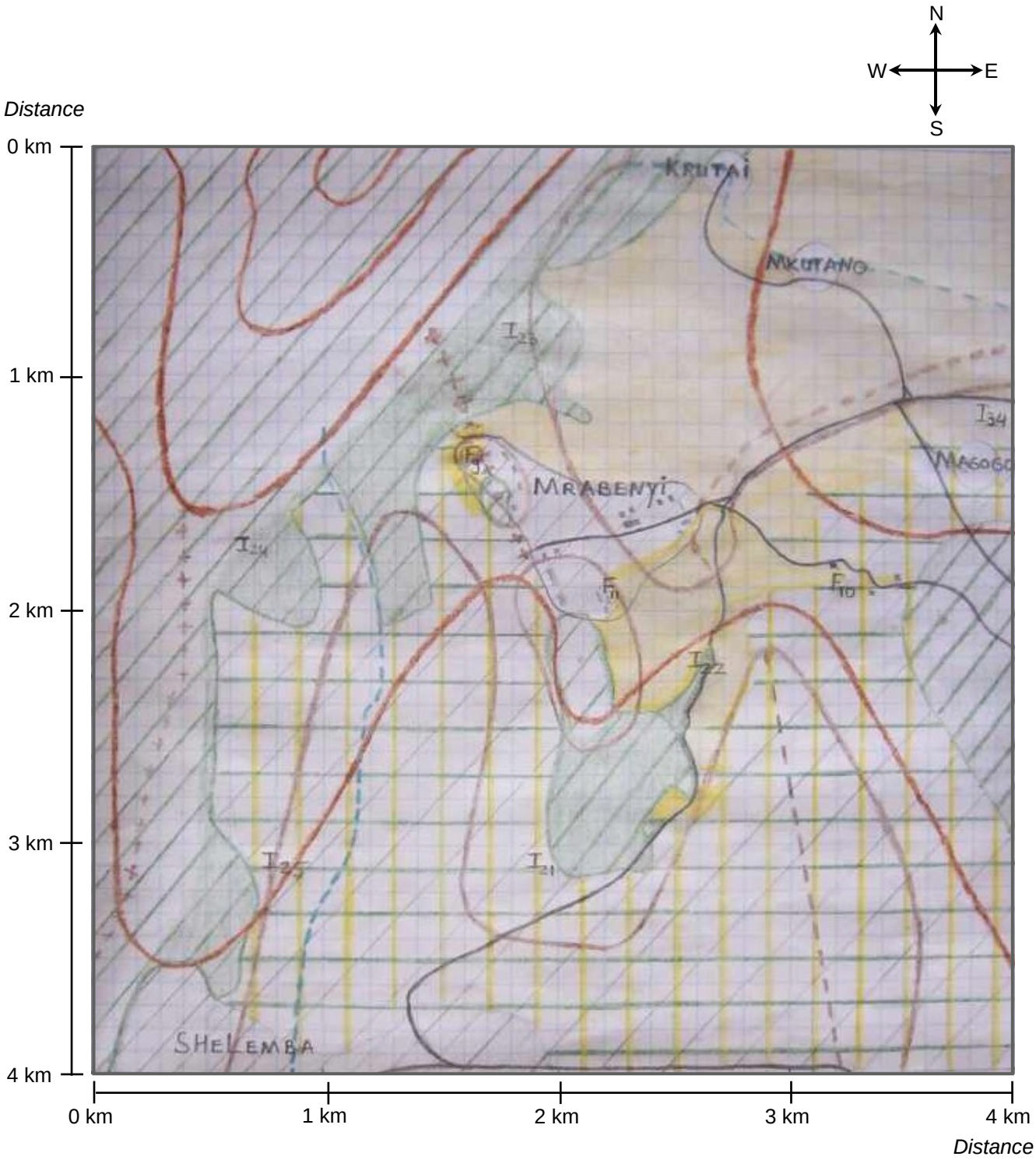
Map 7 C Water flows



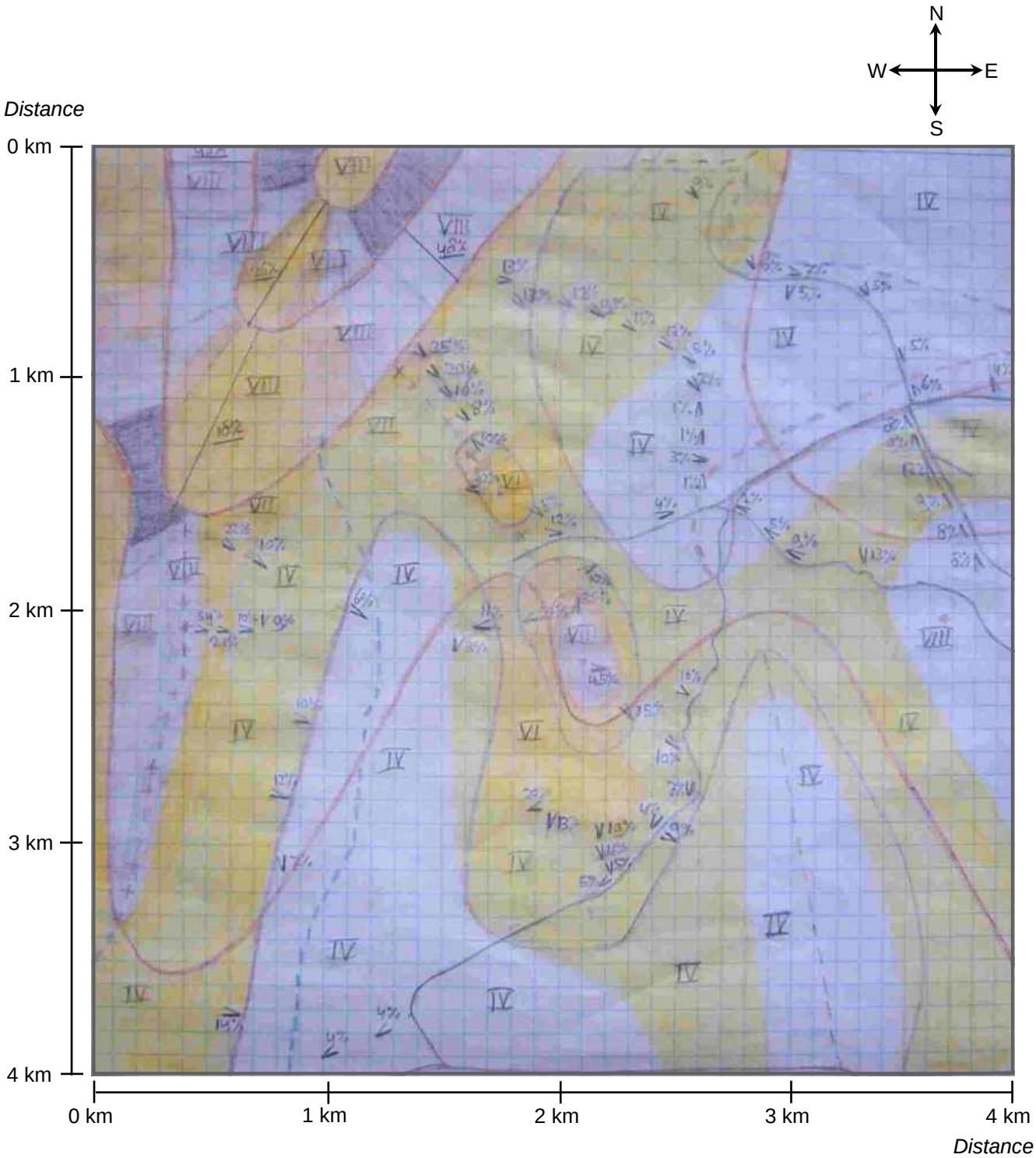
Map 7 D Gullies



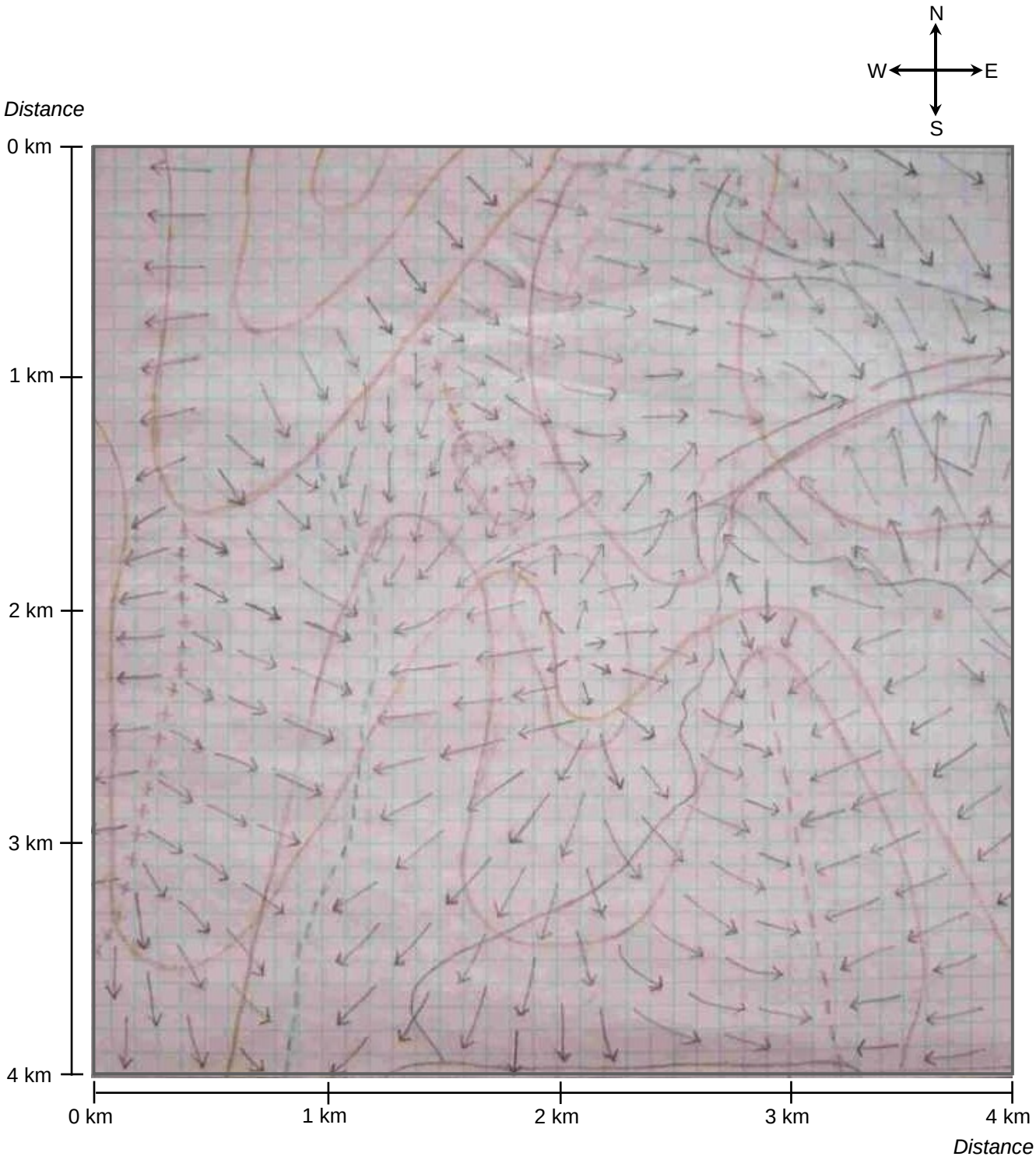
Map 8 A Land use



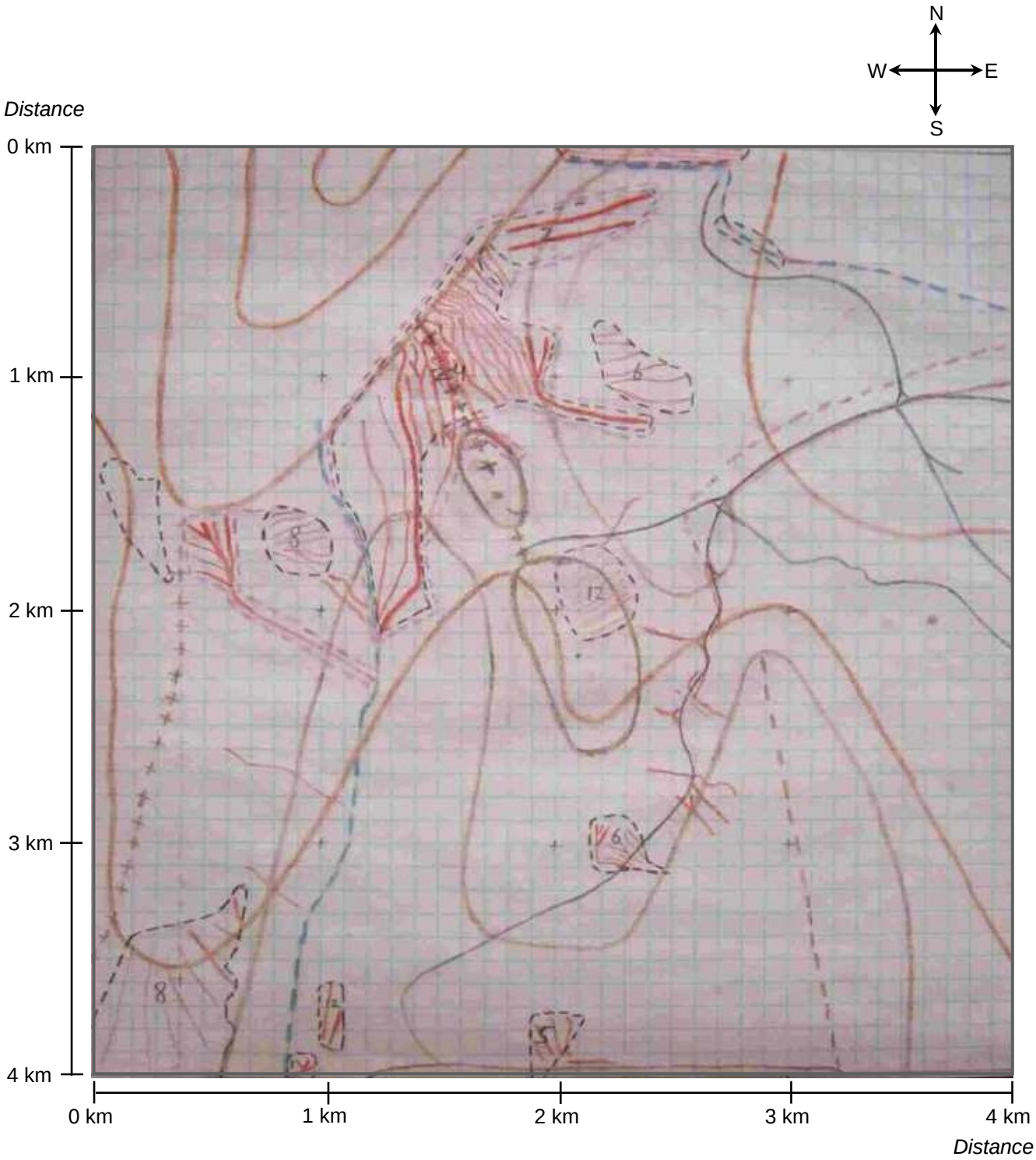
Map 8 B Slope and land capability classification



Map 8 C Water flows



Map 8 D Gullies



Interviews

Questionnaire for farmers

Question 1:
What do you do for your living?

Question 2:
What are the five major problems for you in farming? Could you order them from very important to less important?

Question 3:
Have you problems with the availability of water?

Question 4:
What do you do to harvest water?

Question 5:
Have you problems with erosion?

Question 6:
What do you do to prevent erosion?

Question7:
Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?

Question 8:
Would you like to get help for harvesting more water?

Question 9:
Would you like to get help for stopping erosion on your land?

Question 10:
Have you organised yourselves with other farmers to tackle the problems? Why or why not?

Question 11:
Do you own this land?

Question 12:
Is there a difference between woman and man in farming work?

Explanation of questionnaire

Farmers are chosen as respondent group for the interviews, because they own most of the time land and used a very big part of the research area. Farmers are directly influenced by water shortage and erosion and agriculture is at the same time one of the big causes of erosion and water shortage because of decreasing vegetation cover. Therefore it is important that farmers prevent erosion and have enough water. The problems could be solved the best at the basis, hence at farmers. Because most farmers own land, it is possible to implement projects on their land if they agree and solve the problem in this way at the basis. In Voi have not been conducted interviews because it was not feasible to speak people of the local government. Another reason is that most of the times contacts with the local government could be avoided best because of corruption. WCT tries therefore to operate community based.

The farmers have been interviewed with a standard questionnaire so that answers of farmers could be compared and differences between sub-areas could be determined. The questionnaire contained 12 questions, for both topics, soil erosion and water storage. Only 12 questions were possible to ask, because most of the times the interviews took around 1 hour. According to Hettema (2004) an interview may not take too much time of people; one hour is the maximum. This fist rule has been taken into account. The result of this is that only a few questions could be asked regarding water storage and erosion.
First of all it was needed to know if the people themselves regarded erosion and water shortage as problems. Secondly, information was needed on the motivation of people to prevent erosion and to get more water. Thirdly information about the capacities of people was needed. To obtain all this information, the questionnaire is set up so, that of awareness, motivation and capacities an indication is obtained.
Question 1 is asked to make sure the respondent interviewee was a farmer. Question 2 made clear if erosion and water shortage were important problems for the farmer. Question 3 and 5 made sure if the farmer regards the topics as a problem, especially if it was not mentioned as important problem. Questions 4 and 6 have been used to get insight in the capacities of local people to take actions against the problems they were facing and what they were doing already by themselves to solve the problem. Question 7 is asked to get insight in the history of the problem; what kind of projects were successful or failed so that chance on making the same mistakes in future projects could be avoided. Also it gives insight in the capacities of people, because it makes clear what kind of things the people are capable of and if they maintain projects. Questions 8 and 9 have been used to get an indication of the motivation of people to prevent soil erosion and willingness of people to participate in projects. Question 10 is asked to determine the organization rate and capacities of the people. Organized communities are better capable of big projects than individual people, because the have more manpower. Question 11 has been asked because according to Rwelamira (1999) land ownership is very important for the motivation of people to solve problems they are facing. The reason for this is that if people rent land, they are not sure if the can rent it next year again, so that big investments are not economical. Question 12 is used to determine the capacities of men compared with women and of communities on its own.
It is true that the questionnaire covers only a few topics, however the topics are very relevant and give important insight in local conditions, especially when combined with secondary data and observations in the field.

The interviews have been conducted in such a way that bias as much as possible could be avoided. Therefore no logos, writing blocks, or other equipment were used. Also leading questions were not used and the people got the time to give the answer they wanted to give. It is tried to check the answers that respondents gave by using at least two questions that gave an indication of the same issues. Another way to avoid bias is by taking care of the order in which the questions were asked. For example it is important to ask first what the most important problems of a farmer are, before you ask if he has problems with erosion and harvesting water. Else the people would say that they had very big problems with erosion or water shortage, because they think you want to hear it. To avoid bias the people were not told what the reason was of the visit, because it was observed in the first two weeks that people tried to exaggerate their problems, hoping to get a project, money or food.

Elaborated interviews with farmers

Charles Maghanga Kiteto (F1)

Date of interview: 21th of July 2006.
Area/village: Kirutain ward
Mkwachunyi
Sexe: Male

1. What do you do for your living?
I am farmer and I have also worked by Telkom Kenya for many years, but I retired now.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
My biggest problem is a shortage of water. So, I can't plant and harvest a lot. I would like to grow more, but I don't know what to do.

3. Have you problems with the availability of water?
I get only water in and after the rainy season in October and November, the rest of the year I don't get water.

4. What do you do to harvest water?
Nothing. I would like to drill a well. For that I have 50,000 Ksh. A group was here and they measured the water layer at 200 feet. The Arabs further away have a well, but I am not allowed to use that water, because I am a Christian.

5. Have you problems with erosion?
Yes, water erosion is a problem. The water flows 15 cm over my shamba in the rainy season.

6. What do you do to prevent erosion?
I am making earth walls with branches to stop the erosion.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No

8. Would you like to get help for harvesting more water?
Yes, could you help me?

9. Would you like to get help for stopping erosion on your land?
Yes.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No, my friend let dig some channels. I also want that, but the workers are expensive.

11. Do you own this land?
Yes, I have also got land on the other side of the road. This is 4 acre and the other part is 8 acre. I use rotation agriculture every year between my parts.

12. Is there a difference between woman and man in farming work?
No, man and woman do the same work.

John Mwambacha (F2)

Date of interview: 21th of July 2006.
Area/village: Ikanga
Phone number: 07 35 1699 88
Sexe: Male

1. What do you do for your living?
I am farmer and I work for Telkom Kenya.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
My most important problem is a shortage of water.

3. Have you problems with the availability of water?
The rains of the rainy season are only my sources of water.

4. What do you do to harvest water?
In April 2006 I let dig channels along my shamba and the dug soil I used for constructing two walls beside the channels for harvesting water.

5. Have you problems with erosion?
No, I haven't problems with erosion, because I have got channels.

6. What do you do to prevent erosion?
I let dig channels along my shamba.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No.

8. Would you like to get help for harvesting more water?
-

9. Would you like to get help for stopping erosion on your land?
-

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No, I didn't

11. Do you own this land?
Yes, I do. I own 2 parts of land, one part of 4.5 acre and the second part of 10 acre.

12. Is there a difference between woman and man in farming work?
No, there isn't a difference between man and woman. They do the same work.

Tole Bula (F3)

Date of interview: 26th July 2006
Area/village: Voi
Sexe: Male
Note: His plots are near a sand storage dam in the Voi River. This farmer is asked some extra questions, because he uses the reservoir of the dam.

1. What do you do for your living?
I am farmer. I cultivate paprika, maize, tomatoes, and coriander.

2. *What are the five major problems for you in farming? Could you order them from very important to less important?*
    1. It is expensive to buy fuel for my pump
    2. Erosion during the rainy season, then my crops are flowed away by the water.
    3. It is hard to get good coriander seeds. I buy my seed from the Netherlands.
    4. The available amount of water in the reservoir.

3. *Have you problems with the availability of water?*

No, since the dam has been constructed I have no problems. Now I suite more water, but last year the dam didn't work very well and the reservoir was dry for two times. But the dam works well again now. The five dams prevent the river for drying up.

4. *What do you do to harvest water?*

I have got a pump and irrigation tubes, so I can pump water from the river or reservoir for irrigating my land. (A pump cost 45,000 Ksh and tubes a seven meter cost 500 Ksh)

5. *Have you problems with erosion?*

Yes, a lot. In November and December a lot of water flows over my shamba and the river goes outside her riverbanks. The water washes my crops. Last year all of my coriander was washed. In these month agriculture isn't possible, because there is two feet water on the land. That water comes from the hills and washes the soil from my shamba.

6. *What do you do to prevent erosion?*

Nothing. I think if another dam should be built near my shamba, my problems could be solved.

7. *Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?*

Yes. Some dams are built in the river, totally four. Through those we almost have water for the whole year and the river don't dry up. Along the river it becomes greener and there is more water until 40 meters from the river through the dams. Fifty persons have profit from the dam beside my shamba. Downstream they have drilled a well, which is fed by the water of the reservoir, because the amount of groundwater increases. There weren't projects for stopping of erosion.

8. *Would you like to get help for harvesting more water?*

No, the dam provides enough water and I have a pump, so I can pump water out the reservoir.

9. *Would you like to get help for stopping erosion on your land?*

Yes. I would like to get help for stopping erosion. I don't want trenches, but when an extra dam is constructed downstream, my problems will be solved.

10. *Have you organised yourselves with other farmers to tackle the problems? Why or why not?*

No, everybody work individual.

11. *Do you own this land?*

No, I rent the land from a big landowner.

12. *Is there a difference between woman and man in farming work?*

No. There isn't a difference between mans work and woman's work, but my wife is more at home for the children.

13. *Do your yield increase after building the dam?*

Yes. Firstly, I get 8 bags of maize of 50 kg from 800 m^2. Now I get 16 bags maize from the same piece of land. I also have less costs of fuel for the pump, because the water level is higher.

14. *For what purposes is the dam used?*

Especially for irrigation, but in the rainy season it is also used for crossing the river. That is very dangerous, because then the water flows very fast through the river.

15. Who maintains the dam?
Nobody maintain the dam. Also, that isn't necessary. I think the organisation of the dam do the maintenance. Some people have been there for looking to the dam.

16. Who manage the dam or is there a committee?
Nobody manage the dam and there is also no committee. I would like to manage the dam, so I can prevent that people use the dam in the rainy season for crossing the river and drown.

17. On which depth is the rock layer?
About 7 till 9 feet (2,3 till 3 meter)

Eldest sons of director Sisal Estates (F4)

Date of interview:	4th August 2006
Area/village:	Voi
Sexe:	Male
Note:	This person is only asked some questions during a visit of the Sisal Factory.

Have the Sisal Estate problems with the availability of water?
No, because the sisal plant needs very little water.

Have the Sisal Estates problems with erosion?
No, not really. Only near the factory is a very big gully, but this one comes from a far end away. On the estate aren't gullies.

On which depth is the rock layer?
The rock layer is at many places more the 0.5 m below ground level. (In practice it turns out that the depth is very changeable)

Is the sisal industry going well at the moment?
Yes, with sisal can be earned a lot of money. 4 ton sisal yield 25,000 Ksh. We use the eldest and the best species, Selena. After 25 years the sisal plant is out of flower and then the flower stem can be sold for a lot of money. The stems are used for constructing of houses. Beside this, a lot of sisal is sold to abroad, especially to Canada. This country buy the still unprocessed sisal leafs which they transport to big water cisterns. The factory can provide three qualities of sisal fibres. The best quality is used for making mattress and selling to Europe. The moderate quality is used for producing of ties, drainage tubes, mat, and etcetera. These products go to European countries like the Netherlands and Germany. The low quality stays in Africa. This is from the refuse part of leafs. That is used for mattress and construction material.

Director of Sisal Estates (F5)

Date of interview:	14th August 2006
Address:	G.M. Voi Sisal Estates P.O. box 10 Voi
Phone number:	07 21 4653 20 043 300 15
Sexe:	Male
Note:	The director is asked more questions, because he is a smart man with a sharp view and a big stakeholder in the research area.

1. What do you do for your living?
We have a sisal estate of 7,000 acres and an orange estate of 200 acres. We have also a doctor's post.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Erosion, especially the erosion caused by the people who mining construction sand in the river.

2. The Politicians are also a problem. They demand money from us for many things. They also want to get our land for selling or donating to the poor.
3. Water; in the past it was much wetter. Now it is much drier, sometimes it is almost too dry.
4. The market of oranges to Europe and USA is closed for us, because the flowers get priority and a lot of government officials are corrupt.
5. Larceny of sisal and oranges.

3. Have you problems with the availability of water?
In the past we haven't, but nowadays we get more and more problems. All the retired people buy a water pump and start with growing tomatoes. So, there is a shortage of water in the river. Upstreams, from Wundanyi to the station a lot of farmers cultivate crops, like bananas, cassava, sugarcane and tomatoes. That's why downstream is a shortage of water.

4. What do you do to harvest water?
Now we have got six wells, so we have enough water. Sisal doesn't need a lot of water; one rain a year is enough. However, in the past was much more rain. Water is necessary for the processing of sisal in the factory. Water is also necessary for cultivation of oranges.

5. Have you problems with erosion?
Yes, sure. In the river a lot of sand is mining transporting from upstream by the river. Because of that the river is change her direction and so it threatens the estates and the factory. On the estates we haven't problems with erosion.

6. What do you do to prevent erosion?
We use strip-cropping for preventing erosion on the estate: grass, sisal, grass, and etcetera. Beside this we also do cultying for water retention. To stop river erosion caused by people, we took action by reporting the problem to the politicians, the municipal council of Voi. The municipal council didn't want to do anything. We even reported by the chiefs of districts, but they also didn't do anything. They even gave the sand miners shovels and buckets for hoping to be re-elected. Because they would like to continue their powerful position, the politicians don't take action against these people. I have still tried to avert them from my land, but the only effect was fight and they even burnt the sisal. Thus I have to accept it now.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No, there weren't projects to stop erosion. In the river are built some dams for retention of water for local farmers. The ministry of water does nothing and is very corrupt. They do nothing to decrease the velocity of the water that comes from the hills. Nearby Kilombo is a water project of the European Union. The reservoir is repaired and at the moment they construct a straight water pipeline to Voi.

8. Would you like to get help for harvesting more water?
Yes, I would like to have more wells. Trenches aren't useful according him, because it rains too little on the estates.

9. Would you like to get help for stopping erosion on your land?
I don't need help for the estates for stopping erosion, because there is almost no erosion. When it is possible I would like to see that the big gully could be filled up. But this one is so big and strong that I don't know any solution on my terrain, because the gully comes from the hills. Beside this, I would like to see that the sand mining in the river stops.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No, This is the only sisal estate in the area.

11. Do you own this land?
Yes, actually my uncle. The land has firstly been from Germans. These established the estates in 1872. In 1923 my family get it in property. We rent the land every 30 years from the municipal council. Probably, they don't extend the contract, because they want to give the land to local people.

12. Is there a difference between woman and man in farming work?
Yes. Women put the sisal on the lines for drying, while the men cut sisal leafs and pack the sisal in sacks.

13. Why are trees grown on some parts of the sisal estate?
Parts of the area where trees grow aren't cleaned, because it is very expensive to keep clean the field. So, when the trees don't border us we let them. In September we will start to clean these parts and then we are going to replant the sisal. We do the same as on Mwakingali Hills.
Other parts we are coerced to sell to local people and Voi development; 2,000 acre to the cooperation of locals, from which we can partly rent back the land and 3,000 acre to Voi development. This is happened for the resettlement program of the government. Before those, we have sold land below the foot of the Sagala Hills to people remove from the area of Tsavo East National Park.

14. You said that less rain was fallen the last years; do you know the cause of that?
In the past it was much wetter. Nowadays it still becomes drier. A lot of trees are cut for producing charcoal. A lot of hard wood comes from the Taita Hills. Trees are cut and new trees aren't planted, so there is less rainfall, because the evaporation decrease and the ground become warmer. At night people cut sneaky hard wood in the hills. Everybody is involved as well the politicians as the police. That hard wood goes at all to Mombasa, the "Wood from Wundanyi".

15. How much people works here?
700 people work on the estates, including 100 men guards.

16. How many ton sisal and oranges are produced a week?
At the moment we produce 20 tons sisal a week, because of the drought of the last years. In the past the productions was 40 until 50 ton a week. This year we produce 14 tons oranges a week. Last year it was 30 tons.

Article of newspaper received from the director
Daily Nation - Friday 11th of November 2005
Appeal to control sand harvesting

Voi residents have been asked to control excavation of building stone and sand harvesting on the top of Mwakingali Hills to curb soil erosion. Division Forestry officer Moses Wabwaya said this would also save Voi River from drying up. He was addressing students, teachers and the local Kenya Commercial Bank branch staff at Mwangea Secondary School.

Patrick, Director of Orange Estate (F6)

Date of interview:	14th August 2006
Area/village:	Near Voi River
Sexe:	Male
Note:	Patrick is also asked extra questions for getting more insight in the possibilities and environmental impacts in Kenya. The Orange Estate is part of the Sisal Estates.

1. What do you do for your living?
I am chief of the orange estate. The estate is 200 acres. We cultivate oranges from Egypt, Morocco, USA (California) and South Africa. The estate won the third prize for companies producing at commercial scale. We have 1,600 orange trees.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Insects and other diseases. We have trouble with insects, because we are one of the few places with moist, green trees. Therefore we cultivate Mexican plants, which smell like pesticide, so we have less trouble with insects.
2. Concurrency
3. Larceny

4. Erosion
5. Water

3. Have you problems with the availability of water?
Now we haven't. In the past we had, when we cultivated melons and tomatoes on 100 acre. We stopped, because tomatoes had too much concurrency and melons had too much trouble with diseases, because we cultivate too much behind each other. Therefore we have enough water at the moment.

4. What do you do to harvest water?
We have got five wells, three along the river and two in the Small Taita Hills. We have drilled several wells. In a lot of them was no water, the water layer was too deep, too few water or the walls of the well collapsed.
Every orange tree needs 600 litres a two weeks. This is effective 300 litres. Multiply that with 1,600 trees, so we need 960,000 litres a two weeks. We use flood irrigation, because drip irrigation is too expensive in purchase and we have got sufficient water at the moment. We want to purchase drip irrigation, because we want to start with five acres flowers in greenhouses.

5. Have you problems with erosion?
Yes, especially when we started with the estate.

6. What do you do to prevent erosion?
Now we plant grass among the trees and we have excavated the soil around the tree, so the water stay there. Only the ground under the tree crown is open. We planted the trees at the five meters. Only along the roads we have trouble with erosion during big rains.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No.

8. Would you like to get help for harvesting more water?
Yes, maybe for more wells.

9. Would you like to get help for stopping erosion on your land?
No, we haven't problems.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
Nee, this is the only orange estate in the area.

11. Do you own this land?
It is a part of the Sisal Estates.

12. Is there a difference between woman and man in farming work?
-

13. Have you enough remedy against diseases and fertilizers?
Yes, Trucks loaded with oranges go to Nairobi and when they come back they take pesticides and fertilizers. In Kenya are sufficient fertilizers and pesticides. They are still expensive and in March it is difficult to get them when everybody buy them.

14. Why the area is becoming drier?
The climate of the whole world is changing. In the area where I come from, Central Province around Nairobi, it is also becoming drier. In the past it rain s two periods in this area, nowadays it often rains one period per year.

Paul Mwadime (F7)

Date of interview:	16th August 2006
Address:	Paul Mwadime
	P.O. box 223 Voi
Phone number:	07 34 8350 29
Email address:	mwadinekombo@yahoo.com
Sexe:	Male

1. *What do you do for your living?*

I am farmer and I breed some goats and chickens. I sell green maize, amaran and sukumawiki (kind of cabbage). I also have a small trade in Vertiver grass. Besides those, I am vice-chairman of Mseto Environmental group Voi.

2. *What are the five major problems for you in farming? Could you order them from very important to less important?*
    1. Soil Erosion
    2. Poor production and low yields
    3. Water and drought
    4. Lack of knowledge of modern agricultural practices
    5. Wild life
    6. Diseases

3. *Have you problems with the availability of water?*

Yes, the river dries up.

4. *What do you do to harvest water?*

I have got a water pump and I have made terraces, which I fill slowly with water.

5. *Have you problems with erosion?*

Yes, I have a lot.

6. *What do you do to prevent erosion?*

I plant Vetiver grass and Bamboo, both plants take roots about 2-3 meters deep. I have made terraces and I also do strip-cropping, maize, grass, maize grass and so on. I try to stabilize the riverbanks by planting Vertiver grass. I also planted cowpeas trees spread over my shamba to detain the soil.

7. *Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?*

No, not really. A Dutch or Swedish organisation built some dams, one upstream and a number near Voi. They are also at work with trenches and terraces, but that is very costly and a poor farmer can't maintain that. Because of, how he has to deepen the trenches again? So, Vertiver grass is better. A farmer can plant and maintain it by himself.
I made the terraces by myself (about 30 cm high and with one row maize and one row grass). Vertiver grass also averts insects; those want to lay eggs in maize. Vertiver grass is a kind of natural remedy. I make pesticides of it by myself. Besides these, it can be used as fodder, roof covering and it can even be used for producing charcoal, and so it isn't necessary to cut trees for that purpose.
And World Vision gave farmers in this area pumps against a loan.

8. *Would you like to get help for harvesting more water?*

Yes. I can use help for stabilizing the river, so that the river changes from a temporary, season depended river to a perennial river. I don't need help for my shamba. I rent my shamba for five years and I am in the third year.
I have got a pump and a well. Sometimes there are people those badly use the river. They put chemical bottles in the river, while people use the river water for washing, drinking water and irrigation. Vertiver grass converts toxic in food or bind it.
World vision gave farmers water pumps, so they could produce more. Thus, when you dig trenches then the farmers have more water and their crops can grow faster. Have you thought about a market for those

products? The market of crops is collapsed caused by the pump, because the supply was too high. The farmers produce too much and their yields can only be bought on the local market in Voi. We need possibilities to process our products and get entrance to other markets.

9. Would you like to get help for stopping erosion on your land?
Yes. I would like help with teaching the local farmers how to use Vertiver grass. So, we can cultivate more Vertiver grass and we can use it for planting on riverbanks and shambas.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
We have organised ourselves with 25 farmers in Mseto Environmental Group. But the people in the group aren't always action, like happened in every group or committee. That is a problem and besides that there are still problems with a number of people.
Why? Because of you have to improve by yourself you living area. The government does nothing, except they claim that the river is theirs. So, I want to improve my environment. Firstly, I was carpenter, later driver, and then I wanted back to my area for farming. I come from the Taita Hills by origin, but my brothers use our family land. Therefore I rent land in Sagala for five years and two parts in the Sagala Hills to cultivate Vertiver grass. Now I live with my wife and two suns on this part of land of five acre. In the Hills I have 1.5 acre.

11. Do you own this land?
I rent this land.

12. Is there a difference between woman and man in farming work?
No, I do everything together with my wife. There isn't a difference between mans work and woman's work.

Charles Divei (F8)

Date of interview: 17th August 2006
Area/village: Kalombe
Sexe: Male

1. What do you do for your living?
I am farmer; we have got 3 acres land. I also burn charcoal.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Erosion
2. We haven't got a tank for storage of water
3. Fuel is expensive. The money I earn from selling charcoal I spent on fuel.
4. Water and drought
5. It is hard to get good seed
6. Wild life

3. Have you problems with the availability of water?
Yes. In the dry season the river dries up and then we can't irrigate. Therefore I want a dam.

4. What do you do to harvest water?
I harvest water by the water pump and the rains. World Vision gave us the water pump to every five farmers, but we had to pay back the money. At the moment our pump is broken and we have to rent a pump from others. We haven't money for new accessories.

5. Have you problems with erosion?
Yes, erosion is a big problem. In the rainy season the river rises and damages the riverbanks. The river is also going outside her riverbanks and washes all the crops, especially the maize. Besides these, the rainwater and the river water washes away the topsoil.

6. What do you do to prevent erosion?
I do nothing to stop erosion. People here have too few knowledge. People of World Vision have been here to explain what we have to do, a kind of trenches, but they don't give the practical knowledge. Because of that we can't do anything, while I see that the shambas are damaged. It is lack of knowledge to solve the problem. Manpower wasn't a problem, because the farmers help each other. It was questionable if we had enough time for digging trenches, because we also needed time for cultivating crops.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No, not really. There is only a project of WCT that have built a dam downstream. I also would like to have a dam. Beside this, there was a education project of World Vision. They try to learn the people how they can implement erosion prevention measurements. World Vision also gave the pumps and organised the community.

8. Would you like to get help for harvesting more water?
Yes. I would like a dam and trenches. But the people of outside shouldn't do the work. I want to do it with the community, because of the problems and the land are ours. There are enough people to do the work.

9. Would you like to get help for stopping erosion on your land?
See question 8

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?

11. Do you own this land?
My family owns this land and I am the eldest and only son.

12. Is there a difference between woman and man in farming work?
Here the women works on the land, like the men and they do the same work as men.

Jotham Nyambu Mwawasi (F9)

Date of interview: 1st September 2006
Area/village: Msabenyi
Address: P.O. box 248 Voi
Sexe: Male

1. What do you do for your living?
We are farmer and we have a family of eleven members

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Wild pigs and baboons. These wild animals destroy our crops on the shamba.
2. Erosion
3. Drought
4. Elephantsk, those also destroy our crops
5. After the harvest, Weevils effect the stored maize, so the maize becomes toxic and we can't eat it.

3. Have you problems with the availability of water?
Yes, when there isn't rain, but when the rainy season is good then we haven't problems. We have enough drinking water, because that comes via a pipeline from the Taita Hills. So, there is enough water, even for the cows.

4. What do you do to harvest water?
Noting, we are depended from the rainy season.

5. Have you problems with erosion?

Yes. They are especially on the shamba of our neighbour. There is a very big valley through his land. A lot of soil also washes by the rainwater from our shamba. The neighbour made terraces, but after two years the trenches behind the terraces were filled up.

6. What do you do to prevent erosion?
Noting, we do nothing against erosion. We have too few people for making and maintaining terraces by ourselves. We dig the soil and plant the crops. There is also too few knowledge about constructing terraces.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
The FDA (Federal Department of Agriculture) teaches the people in seminars how to take measurement against erosion. They learn the people to put manure on their land, how to construct terraces, how to breed goats, how to hold bees, how to harvest rainwater in holes in the ground with help of plastics. Honey makes a lot of money in Kenya. The people get 100 Ksh every seminar for participating. The seminars are in English, while much people don't speak English. Much people can only speak the native language, Taita.

8. Would you like to get help for harvesting more water?
Yes, we would like to get help for harvesting more water, especially groundwater.

9. Would you like to get help for stopping erosion on your land?
Yes, we would like toe get help by constructing trenches or terraces, especially with knowledge and tools, like shovels and barrows.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
Here people are organised in groups. The people live in groups and help each other with farming and cattle breeding. At the moment groups are organised, leaded by FDA, to construct terraces, so that people can conserve their land and don't depend on relief food of the government or USA. The government gives oil and maize for eating and sowing.

11. Do you own this land?
It's our family land.

12. Is there a difference between woman and man in farming work?
Man and woman do the same work. They do everything together, as well the heavy as the light work. Women must, because else they haven't food, because a lot of men work in the town. They raise cattle and even burn charcoal. Men do more than women, but in principal there isn't a difference.

Tabitha Mavumbo (10)

Date of interview: 4th September 2006
Address: P.O. box 248 Voi
Sexe: Female

1. What do you do for your living?
She is farmer and she has got some goats and chickens. The crops are maize, beans, baazi, green gram, cassava, mangoes and guavas.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Erosion
2. Caterpillars eat crops
3. Drought
4. Wild life, like wild pigs and baboons, those eat my crops. And birds of prey, those eat my chickens.

3. Have you problems with the availability of water?

When enough rain falls I haven't problems, but when the rains are too few I can't harvest.

4. What do you do to harvest water?
I make small earth walls for catching water and I make terraces with grass.

5. Have you problems with erosion?
I have problems with erosion during the rainy season.

6. What do you do to prevent erosion?
I plant grass to prevent erosion in rows, I make earth walls and I make terraces to hold the water. I heart something about it at school.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
FDA organised diverse projects about water harvesting and erosion, but they weren't in this region. When there are lessons I would like to go to them, to talk with other people and to look how they make terraces. Then I can practise it on my shamba. The people get teaching about water harvesting by holes and how to make terraces.

8. Would you like to get help for harvesting more water?
Yes, I would like, because then I have more yield and I am surer about my harvest.

9. Would you like to get help for stopping erosion on your land?
Yes, I would like help and somebody who tell me how I have to make terraces. Then I want to make them by myself.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No, we aren't organised. The most work I do by myself.

11. Do you own this land?
My family owns the samba.

12. Is there a difference between woman and man in farming work?
Men and women do the same work in farming. There is no difference. I also make the terraces by myself. I also construct my own house and I plant and harvest.

Charlton Mwazoka Mushoki (F11)

Date of interview:	4th September 2006
Address:	P.O. box 345 Voi
Sexe:	Male
Note:	This man is asked some extra question, because he is a smart man with a sharp insight.

1. What do you do for your living?
I am farmer. Until last year I worked by the postage. Now I retired. Beside this, I have got a small shop with provision. I rent the building, but I try to build my own shop.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Water for agriculture
2. Drought
3. Animal diseases
4. Erosion
5. Diseases in plants and stored products.

3. Have you problems with the availability of water?

Not really. When there is enough rain it is good. We do rain-fed farming. But when the rains don't come, it is very bad. Outside the rainy season it is very dry. I would like to have boreholes, because there have to be water in the ground. My plants on the end of my shamba are green. That is the effect of my terraces. I see the erosion is really a big problem here. The water washes away all the soil and the water haven't time to infiltrate into the ground. Because of my terraces the water infiltrates into the ground and it streams as subsurface water downhill and I have still got enough water.

4. What do you do to harvest water?
Further nothing.

5. Have you problems with erosion?
Yes, it is a real problem.

6. What do you do to prevent erosion?
I have made terraces to prevent erosion. That doesn't help enough. During the rain much soil is washed away from the terraces. Therefore I plant strong grass on the end of the terraces, so the grass filters the soil out the water.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
Yes. There have been people like you from abroad and five year ago they have done a lot to prevent erosion. They took action to prevent gullies, but then the NGO's went away and the local people haven't enough money to continue. Now nothing happen. Money is a problem here, you see?

8. Would you like to get help for harvesting more water?
Yes. I would like to get wells, below the hill. There is a lot of water at low depth, about 50-100 feet (16-33). But there isn't money, because it is very expensive to drill wells and a lot of materials are necessary.

9. Would you like to get help for stopping erosion on your land?
No, I don't need help for erosion, that is going well.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No. Here it is used that everybody work individual. But if sponsor from outside should come, a plot could be dug for the community, so that there the agricultural activities can be improved. I mean a test plot that is maintained by the community.
Or a committee that manage the wells when these are drilled.

11. Do you own this land?
Yes, it's my own land.

12. Is there a difference between woman and man in farming work?
A dividing of work isn't here. There is only a dividing of work for building houses. Men make bricks and breed the cattle. They often do the heavy work, like inoculation of livestock and prevention of diseases. For that a lot of power is necessary, if you want to catch a cow. In farming we work together. The woman goes earlier to home for cooking. Nowadays, some women do everything by themselves, because the men work in the town.

13. Is the area becoming drier?
Yes. When I was young the area was much wetter. The rain season was from September until December. Twenty years ago it changed. We can't rely on the rains and the rainy season is much shorter. The rain only falls in October and November. This is probably caused by the ozone layer that is changing, the pollution of the factories and so on. It was also much greener in the past. There was a lot of forest. But the people appreciate technology and they want to be rich. So the people started with cutting trees for getting money by selling charcoal and wood. Because of that we only get rains from the ocean and we don't get rains by evaporation of trees and plants.

14. Is the soil fertile?
Yes, really fertile. Before the rainy season I put manure on the top of my land and this wash with the water into the ground and to downhill, so the land remains fertile.

Videt Kofia (F12)

Date of interview: 6th September 2006
Area/village: Kirindinyi village
Sexe: Female

1. What do you do for your living?
I am farmer. I cultivate maize, cowpeas, apple, muchuma, cassava, sisal and mango.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. The fertility of the land decrease, it becomes sandy.
2. Water for agriculture and droughts
3. Erosion
4. To get seeds for planting

3. Have you problems with the availability of water?
Yes, it was very dry last time, especially the last month.

4. What do you do to harvest water?
We are waiting on the rainy season. We do farming depending from rain.

5. Have you problems with erosion?
Yes, I have trouble from it.

6. What do you do to prevent erosion?
I make terraces (walls from wood and earth walls). I also plant trees and grass in rows to prevent erosion. The community helps each other to make terraces by every member of the community.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
No not of other organizations that I know.

8. Would you like to get help for harvesting more water?
Yes.

9. Would you like to get help for stopping erosion on your land?
Yes.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
Yes. The community is organised and helps each other by farming. The community count 159 members. The community has various projects to get water and to prevent erosion. We have tried to get water pipes, so we can get water from the Taita Hills. Beside this, we make together terraces and plant trees and grass to prevent erosion. We try to collect money for these projects from MP's (Members of Parlement) and DC (Districts Commission) in Wundanyi.

11. Do you own this land?
I own this land.

12. Is there a difference between woman and man in farming work?
Men and Women do the same work in farming in this area. There aren't differences.

Elisabeth Bahati (F13)

Date of interview: 8th September 2006
Area/village: Mwangkarana
Sexe: Female

1. What do you do for your living?
I am farmer. I am also tailoring and sometimes I am day-labour of digging.
On the farm she has goats, sheep's, cows, ducks and chickens. She has got ¾ acre land and still rent a part land. She grows beans, maize and cowpeas.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Water
2. Insects on the land
3. Bad seeds
4. Glutton in storage
5. Lack of knowledge of rotation of crops and modern agriculture.
6. Lack of knowledge to make terraces and prevention of erosion.

3. Have you problems with the availability of water?
Yes. It is dependent of the rain season, but when it is bad I even haven't drinking water.

4. What do you do to harvest water?
They asked a MP to organise a water pipeline. He said that there isn't money for a pipeline from the Taita Hills. In 1998 they colleted 100 Ksh per household for a water pipeline form the Taita Hills, but the costs were higher then thought. Therefore we still haven't a pipeline.

5. Have you problems with erosion?
No, I haven't problem.

6. What do you do to prevent erosion?
I plant grass in rows. Further I have a number of trees, but that only are four, because my shamba is so small. In the area are problems with erosion. At a short distance there is an big gully that gives a lot of problems.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
There weren't many projects for water. For erosion control were seminars of FDA about how to make terraces. But the women participating the seminars don't still know how to make terraces or they don't share the knowledge. Lack of knowledge is a big problem for me. I would like to get more knowledge.

8. Would you like to get help for harvesting more water?
Yes, I would like, because the soil is suitable for irrigation, then we could cultivate onions, skumawiki and tomatoes, and we have more water.

9. Would you like to get help for stopping erosion on your land?
Yes, I would like to get knowledge about how to make terraces.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
We have a women group of 20 women helping each other with preparing the shamba's. A small amount of money has to pay for it. We put with the community brunches in the wadi to control erosion when the chief says it. We also do other things when the chief says that it is necessary.

11. Do you own this land?
Yes. I have got ¾ acre and I still rent a part, but that is very problematic here. Often, when I finish preparing the land for the rainy season, the owner demands the land for himself.

12. Is there a difference between woman and man in farming work?
Men and women do the same work.

Elias Mwatela Banjoni and Nebert Ituka Banjoni (F14)

Date of interview: 8th September 2006
Area/village: Feet Taita Hills
Sexe: Male
Note: This two man are brothers and they cultivate their family land.

1. What do you do for your living?
We are farmer. We cultivate maize, cowpeas, cassava, pigeon peas, cashew nuts trees and other fruit trees. We have also got cattle.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Water
2. Animal diseases
3. Plant diseases
4. Erosion

3. Have you problems with the availability of water?
No. Drinking water comes from the hills and when it rain there is enough water.

4. What do you do to harvest water?
We are only waiting for the rains.

5. Have you problems with erosion?
Yes, there is a lot of erosion.

6. What do you do to prevent erosion?
In the rainy season the water washed away the topsoil layer. Therefore we plant grass in rows and we make earth walls/terraces. We also make bench terraces (and a kind trench).
7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
In the years 1985-1990 here was a project of the Danish government. They taught the people to make terraces and take action against gullies. One day every week the Kenyan government obligate the farmers to implement erosion prevention measurement. We have to plant grass, trees and plants, and we have to make stonewalls and terraces.

8. Would you like to get help for harvesting more water?
Yes, we would like to help for getting water. We would like to have a well.

9. Would you like to get help for stopping erosion on your land?
No. Erosion prevention measurement we take by ourselves. (They are also making terraces)

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
In the past the community was organised, but now it doesn't. Nowadays everything is more individual. I don't know how that comes.

11. Do you own this land?
The land is ours and from some others. We are all brothers.

12. Is there a difference between woman and man in farming work?
There isn't a difference between men and women.

Joshet Willy Idawo (F15)

Date of interview: 11th September 2006
Area/village: Ikanga
Address: P.O. box 240 Voi
Sexe: Male
Note: Translated by teachers of Ikanga Primary School.

1. What do you do for your living?
I am farmer. I cultivate maize, cowpeas, green peas and cassava.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Bad harvest
2. A shortage of rains
3. Damage of plants by diseases
4. Damage of plants by cattle
5. Erosion

3. Have you problems with the availability of water?
Yes, there is too little rain.

4. What do you do to harvest water?
I am only depended of the rain for harvesting water.

5. Have you problems with erosion?
Yes.

6. What do you do to prevent erosion?
I plant grass in rows, but I don't know how I can make modern terraces. I would like to know that.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
There is a water project, but the project doesn't work. There isn't water in the wells. Beside this, there aren't other projects.

8. Would you like to get help for harvesting more water?
Yes.

9. Would you like to get help for stopping erosion on your land?
Yes.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
No, we work individual. There aren't community groups.

11. Do you own this land?
Yes, I own my land.

12. Is there a difference between woman and man in farming work?
No. Men and women do the work together. There isn't a difference between men's work and women's work.

Martin Mwadime, Douglas Mareko and Elius Mwakelemu (F16)

Date of interview: 11th September 2006
Area/village: Mdanda village
Sexe: Male

1. What do you do for your living?
We are farmers. We have a shamba for own use and 1.5 acre for cash crops. We cultivate maize, cowpeas, green peas and cassava. We have also got some chickens, cows and goats.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. Drought and a shortage of rainfall
2. Disease of crops
3. Termites

3. Have you problems with the availability of water?
Yes. We are depended of the rainy season. Now we are busy with preparing the land.

4. What do you do to harvest water?
We are waiting for the rains.

5. Have you problems with erosion?
No, we haven't real problems.

6. What do you do to prevent erosion?
We planted grass in rows and we made kind of terraces. Therefore we haven't problems with erosion. The soil reasonably stays.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
The Egypt government drilled wells, but the water in the well isn't good. It contains too much chemicals. Another project is from KWS (Kenya Wildlife Service). They built a water tank and pipelines, so water can be pumped from the well into the water tank, but the water isn't good.
In Tausa FDA gives seminars about erosion prevention measurements. When someone want information about making terraces, he goes to them and they teach it.

8. Would you like to get help for harvesting more water?
Yes. When a well could come with clean water, like some distance further, then we can use irrigation. The pipelines are already constructed.

9. Would you like to get help for stopping erosion on your land?
No, We already can make terraces and plant grass in rows.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
In the past we were organised, but now everybody work individual. Because of everybody need money for taking care that his children can go to school and get food. Therefore, there aren't collective projects.

11. Do you own this land?
Yes, We do.

12. Is there a difference between woman and man in farming work?
No. There isn't a difference in man work and woman work, because women have to help due to all the rainfall in one time and then everything grows very fast. Therefore, we can use all help for preparing the land, seeding and weeding.

Beatrice Musembi et al (F17)

Date of interview: 22th September 2006
Interviewed women: Beatrice Musembi
Clemence Kinyonji
Anastacia Mwamela
Florentina Wawuele
Area/village: Voi
Sexe: Female

1. *What do you do for your living?*

We are farmers. The crops are pompons, watermelons, potatoes, tomatoes, maize, cassava, skumwiki, papayas, bananas, beans, peppers, cabbage and spinach.

2. *What are the five major problems for you in farming? Could you order them from very important to less important?*
    1. Water (there is no water in the Voi River in September and October)
    2. Diseases of plants and insects
    3. Money for pump hire
    4. Money for hire of pipes for irrigation
    5. (Money for) good seed
    6. Thieves, those steal the crops

3. *Have you problems with the availability of water?*

Yes, when the river is dry.

4. *What do you do to harvest water?*

We rent a pump and pump water out the Voi River, so we can irrigate. And we get water by the rains.

5. *Have you problems with erosion?*

No, here on the shambas it isn't a problem. Nearer to the river there are problems. There the soil is flushed away by the river.

6. *What do you do to prevent erosion?*

We make earth walls on our shambas, and then it isn't a problem.

7. *Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?*

Yes, a dam is built in the river for getting more water.

8. *Would you like to get help for harvesting more water?*

Yes.

9. *Would you like to get help for stopping erosion on your land?*

No.

10. *Have you organised yourselves with other farmers to tackle the problems? Why or why not?*

Yes. We have a self-help group, Mseto Ukulima Group, with 17 members (M.U.G., logged by the municipal government). We help each other with digging and we have got a collective shamba. The crops of this shamba we sell for renting together a pump and pipes for irrigation and for keeping the pump operational.

11. *Do you own this land?*

We rent these shambas

12. *Is there a difference between woman and man in farming work?*

No, here isn't a difference between man work and women work. We do everything together.

The members of Mseto Ukulima Group is mainly a women group, there are only four male members. The 13 women are the heart of the group. Their names are: 1. Josphine Ngaluma, 2. Anastacia Mwamela, 3. Nrumi Mwasvasi, 4. Florentina Wawuele, 5. Mary Maglema, 6. Clemence Kingonje, 7. Beatric Musembi, 8. Lidya Mwanyaio, 9. Hellen Talu, 10. Mes Hamisi, 11. Mwaiko Mwashoti, 12. Mwarimbo, 13. Abdall Jume.

Leah Mcharo (F18)

Date of interview: 25th September 2006
Area/village: Kalambe
Sexe: Female
Note: Translated by Tito, employee Excellent Development. This woman is asked some extra questions, because trenches are dug on her plot.

1. *What do you do for your living?*

I am farmer. I cultivate maize, cassava, cowpeas and tomatoes. I had papayas and sugarcane, but the elephants ate those all.

2. *What are the five major problems for you in farming? Could you order them from very important to less important?*
    1. Sufficient rainfall
    2. Wild life, especially elephants
    3. Bad fertility
    4. Bad harvest
    5. Erosion, especially near the river

3. *Have you problems with the availability of water?*

Yes.

4. *What do you do to harvest water?*

Sometimes I irrigate on one shamba. There I cultivate tomatoes. For that I rent a pump. I don't irrigate on the other shambas. There I am depend on rainfall.

5. *Have you problems with erosion?*

Yes.

6. *What do you do to prevent erosion?*

I plant Napier grass along the river, so the riverbanks remain strong and the river don't flush away my land. The shamba near the river is flushed away for a big part. Besides these, I do nothing. On the other shamba trenches are dug by WCT to prevent erosion.

7. *Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?*

Yes. World Vision gave pumps to farmers, so they can irrigate. World Vision helps the farmers with working together in groups and using a water pump. However, many farmers don't use the pump. Upstream, the farmers are very active, but in the village is a problem. Here, the most people are lazy and they don't see farming as a way to escape of poverty and they are depended on relief food. Due to World Vision has given relief food to people for almost a year. This month was the last month that people get food. So, the people get it hard from now, because they haven't other source of food.
There also were people doing research to sites for boreholes. These people were probably of the Kenyan government.

8. *Would you like to get help for harvesting more water?*

In this area is a lot of potential land for agriculture. When it rains then we have a good yield. But the most shambas look left. Here the soil has a good structure and when it rains the plants don't die mostly of the time. But the biggest problem is rain. Now farming is getting better for a little by the pumps, but the groups of five people are too big. One farmer can use the pump maximal one time per week, while with groups of 2 or 3 we can irrigate much more land.
There weren't other projects for erosion beside the projects of WCT.

9. Would you like to get help for stopping erosion on your land?
Yes.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
The community didn't anything to stop erosion or to get more water. What we do together is to construct and to maintain the road to the village and the school. It is better to decide by myself what is necessary about water and erosion.

11. Do you own this land?
Yes, but we haven't title deeds. The government hasn't still research the area for giving everybody a title deed. Now it is community land.

12. Is there a difference between woman and man in farming work?
In farming isn't a difference between men and women. They do the same work. A difference is that the woman cooks and takes care for the children. Men look more outside the area for example in Mombasa or Voi. Men mostly raise the cattle in the bush, but the women also do it. So, there isn't a difference.

13. How did you involve in the project of WCT?
They started with building the sand storage dam. After that Peter told the community that he wanted to help the community with more water and stopping erosion when the flush floods comes. Peter said that he should show the community how to do on some shambas, so that they know it. The other shambas they have to do by themselves. I was lucky that my shamba is near the river and the sand storage dam, so her shamba was chosen. The water that flows into the trenches has to be enough for three month, so I can cultivate my crops.

14. How are you going to maintain the trenches?
I am going to maintain the trenches on my shamba by myself. I will plant Napier grass on the walls and on the top of the walls of the trenches to prevent collapsing of them. In the trenches I want to plant bananas trees. The flood is so big that trees and even people stream from the hills to beneath by the water. Those can fall into the trenches. I will try to dig the soil out of the trenches so much as possible.

15. How are you going to maintain the dam?
The community will maintain the dam. For that the chief of the village will call the community together. What are you going to do with the leak of the dam? Maybe, some people having interest in the dam for their shambas can do anything by putting cement into the leak.

16. What have been done in this area about farming, water and erosion?
It should be nice when trenches will be dug at the side of the Sagala Hills, because there always comes a lot of water from these hills. Then, that water can be catch by the trenches and there is less erosion.

Josua Mshoke (F19)

Date of interview:	25th September 2006
Address:	P.O. box 93 Voi
Sexe:	Male
Note:	WCT let dig trenches on the plot of this farmer last year.

1. What do you do for your living?
I am farmer. I haven't an other job. I cultivate crops and I get milk from the cows. The cows give 15 litres a day and that I sell. The crops are maize, cassava, beans, peppers, bananas, coconuts, papayas and tomatoes.

2. What are the five major problems for you in farming? Could you order them from very important to less important?
1. A shortage of water

2. Fuel for the water pump is expensive and sometimes I haven't money for fuel and then I haven't water in the dry season.
3. Disease of crops. I use chemicals to fight them, but these don't work good enough and I haven't always money for them.

3. Have you problems with the availability of water?
Yes. It is dry for a long time every year and some month a year the river is dry.

4. What do you do to harvest water?
I use a pump for irrigation and trenches are dug for harvesting of rainwater.

5. Have you problems with erosion?
I haven't problems with erosion. I hadn't also problems for the digging of the trenches.

6. What do you do to prevent erosion?
The riverbank and the walls of the trenches I have planted with Napier grass.

7. Have there been any projects for stopping erosion and/or getting water? What did they do? What was the result?
There haven't been projects here, except the projects of the dam and the trenches.

8. Would you like to get help for harvesting more water?
I got help with the trenches.

9. Would you like to get help for stopping erosion on your land?
Idem.

10. Have you organised yourselves with other farmers to tackle the problems? Why or why not?
The farmers don't help each other. I work with my wife and children on my shamba. When it is necessary I rent a worker.

11. Do you own this land?
I owns this land, it is about 4 acres.

12. Is there a difference between woman and man in farming work?
Men and women do the same work in farming,

Elaborated interviews with people of WCT

Joshua Mukusya

Date of interview:	24th July 2006 & 5th October 2006
Sexe:	Male
Note:	He works for Westerveld Conservation Trust and he is also exclusive director of Excellent Development, a Kenyan NGO. He is the supervisor of the authors of these reports.

Interview on 24th July 2006

How do you involve people in a project?
In Machakos, Makueni we started with the Gamba tribe in the village Antonie. There the people help each other and they do everything together. For that they have diverse groups and committees. In Antonie we have established a water committee in cooperation with the community. That was a great success, so now the people come by themselves to me for asking help. In Voi it is going different, there a lot of tribes live mixed in the area. So, there isn't a community structure. For that the people are difficult to approach. They also think much bigger than the people in Makueni. Here the people also want to get money for

anything. Therefore we started with trenching by some individual farmers. Employees of WCT, who we have to pay, dig trenches on their lands. We hope that the other farmers also want trenches and that they are convinced when they see that it works by these farmers.
In Amboseli we also do it different. There live the Maasai. This community is very conservative and they don't like differences. There we ordinary started with two trenches at the prerequisite; when it doesn't work, we refill the trenches and make the ground flat. However, it works so good, that we very busy with digging trenches and we have convinced the community. By principal, we always approach the chief of the community firstly. We have a meeting with him and then we try to convince them of the usefulness of trenches. When the chief is convinced, we continue with a meeting with the whole community and we ask them what they expect from the project. When the chief doesn't participate we stop with approaching them. When they want to participate then we look to the differences among the people and the problems regarding the expectations of the benefits of the project. We try to solve these problems, so that we get along a group as big as possible. Then we organise a second meeting for deciding to give green light or to stop with the project. After the decision we start or stop with the project.

What do you do to take care of the maintenance of the projects?
When the trenches are dug maintenance isn't necessary.

Do you organise the people by, for example, establishing committees?
Yes, in Amboseli we chose for establishing a committee. There 3000 people elect a committee of 10 people. In Machakos the people have already done this by themselves. Further, we don't organise the community directly.

How many projects do you have at the moment?
At the moment I have 43 projects running through whole Kenya and in the area of Moshi, Tanzania.

Interview on 5th October 2006

Why did you not start with trenching in the Taita Hills?
We didn't start trenching in the Taita Hills because the people there would have food for the project. The community wanted first to get relief food before they wanted to work on the building of sand storage dams and digging of trenches. I told them that I was not planning to give them food. We could provide them with building materials, but they had to do the work themselves.

Where have you been in the Taita Hills?
We have been a lot in that area, we went all along the Voi River. We had talks with the community of Msau. But the people wanted only relief food. The government is spoiling those people by giving them relief food. It makes the people lazy. The FDA has to learn the people how to cultivate their land and to provide with water. But what do they do? They give them relief food and the people are happy with the government because the got food!

What do you think of the working method of World Vision in the Voi River catchment? I mean that they are giving the people relief food and water pumps for irrigating their crops?
World Vision is only giving the people "small" things and they don't encourage people to do things themselves. They give the people relief food. Because of that the people get spoilt and they're getting lazy. Also they give the people pumps, but they don't teach them well how to do modern farming. The people start cultivating and irrigating, but they're not aware that they are spoiling their plots. The crops are standing for a long time in the water, because the people are flood irrigating their plots and they use boxes for planting their crops. Because of that plants get diseases and the diseases are spread with the irrigation water. So after a few harvests the people can't cultivate tomatoes, beans and potatoes anymore, because the disease has spread into the ground.
World Vision don't provide the communities with knowledge and because they give the people relief food they don't encourage people to think and solve problems on their own.

What are the plans of Westerveld Conservation Trust with the Voi River catchment in the future? Is WCT planning to trench the area and to build more sand storage dams in the Voi River?

We want to have a local NGO in Voi, because I have no time for it. I'm too busy in Makueni and I will be very busy in Moshi in few months from now. So there is no time for me to drive all the time from Machakos to Voi and back, only for paying the people and inspecting the sites. Also I have no time to supervise all the students that are doing research in the Voi River catchment. So it is better to establish a local NGO, which can deal with the local chiefs and government and make a plan for the catchment. Also the student can be supervised better. My lawyer is on the moment busy working out the official details. I'm looking on the moment for people who can manage the NGO. I have a Maasai fellow (Bernard, employee of WCT in Amboseli red.) who probably is suitable of managing the project. But I have to find at least one or two other people who can help him. I don't mind to help them with starting up the NGO and maybe to join the board and give them advise, but after a year or so it has to work.

What do you think of the farming practises of the farmers along the Voi River? Are they doing a good job on the moment or not?
The farmers are not doing their job well. First of all they are using flood irrigation. I told Joshua (Joshua Mshoke red.) also already several times that he had to stop irrigating the crops like he is doing it now, because he is using boxes in which he plants his crops and than he flood irrigates them. Because of this the roots of the plants are for a long time in the water and they get diseases. After a while the ground is bad because the diseases have spread. They can't cultivate tomatoes, beans etc. anymore. They've to make furrows in which to put the water and they have to plant their crops on top of the "earth walls". So they don't soke the plants and they get no diseases.
Secondly they're cropping too much. They don't give their land enough rest. They've to divide their land in parts and they have to crop every part one time a year so that the land gets not exhausted. Also they have to put the residues of the crops in the trenches so that the water can take the fertilizers into the soil. They have to pay more attention on the fertility of the soil. They have to use manure or compost well.
Thirdly they have to rotate their crops better. They only may plant tomatoes on the same part of their shamba once in the two years, else the soil gets bad. Now they are cropping all the year round, harvesting three times a year and they don't rotate well.
Also the farmers are using fertilizers and chemicals. I'm always saying that the people don't must use these products, because you get only diseases by using these products. I try to teach farmers to do organic farming. I only use compost and manure to keep the ground fertile enough. Also this makes the soils better. I have no diseases because I don't use these Western hybrids, which may give you high yields, but also a lot of diseases and costs for chemicals. I obtain my own seeds from the plants I'm cropping. These plants are much more resistant for diseases. I also want to build my own organic farming school. Yes, this old man has mad plans. I want to start an organic farming school in Metito Andei, where I bought around 12 acres. I want to teach the Gamba and Samburu people over there how to do farming.

What would you do to stop gully erosion? Because I saw a lot of gullies in the Voi River catchment and have some ideas of what to do. But I would like to know what you as expert would recommend.
You can stop gullies by making dams. But you have to make sure that they don't flush away. The Kenyan government with the Danish government have done a lot to stop gully erosion in Kenya. The project was called DANIDA. It has now been stopped, because it was not working. They continued under another name. The project was not working well, because the Kenyan government was corrupt. If they had to use 2 sacks of cement they used for example one. So the dams flushed away. So you have to make the dams strong enough and the foundation well. Sand storage dams are different from dams in gullies. Sand storage dams are in a river and the water is streaming with not so much strength as in gullies. Dams in gullies have to be high enough, because the funny thing with water here is that it flushes the soil away that is lying behind the dam. But the dams can also not be made too high, because else they will be too expensive. To keep the soil behind the dam you have to put picks in the ground and tie branches at them. Also you have to plant trees and napier grass. The trees, grass and branches will catch the ground that's in the water. If you do this, you can stop gullies.

What is your suggestion for stopping erosion at the foothill of rock(y) hills on which you can not store water well?
Hills on which vegetation can not grow and trenches can not be made, you can stop gullying by controlling the way water if flowing. You can protect the foothill by putting a wall around the hill that blocks the water. The water has to be carried away trough a channel. By this way you can protect the foothill of devastation.

Which characteristics are you looking for when you're searching for an appropriate dam site?
I'm looking for a rock layer that goes from one side of the river to the other side, that's not too deep below the surface. But you have to make sure that the rock bottom is not porous or eroded. It has too be a solid rock. I'm looking for a rock layer because it is cheaper than constructing a dam on sand. On sand you need to have a good foundation, however sand is possible of course. Also you have to make sure that there is no black cotton soil near the dam side. Black cotton soil, if it dries out it crusts severely and when it is wet is can propagate piping. So it is an unstable soil.
Further you have to make sure that there is community near by who wants to build the dam. The labour has to be done by the community. This is the best because you can make them responsible for the dam and can keep cots down. So the first thing you have to do when a community is willing to build a dam is to register a self-help group. By this way you've somebody who's responsible for the dam and who you can look for if there is something that needs to be done. Also it gives the group the right to exploit the benefits of the dam, so that they can profit of the dam. They could sell the water or use it for themselves. Also the government knows by this way officially of the existence of the group and the dam.

Peter Westerveld

Date of interview: 24th July 2006
Sexe: Male
Note: He is the founder and director of Westerveld Conservation Trust.

What are exactly the goals of Westerveld Conservation Trust?
The goals of WCT are:

1. To give people water for domestic use
2. To get water for agriculture
3. To get water for nature
4. To stop erosion

Why did you choose for a project in the Voi River Catchment?
We started with the Voi River Catchment, because it isn't very big and it contains all the water related problems for people, agriculture, nature, and erosion problems in a small area. In the past the area was much greener, so the area matches well in the frame of REAL. We want to prove the world with the Voi River Catchment that our method works and that it can provide that the area become evergreen again and in natural balance. Thus, we want to show with this area that an area can be improved, made greener and stabilised by good water management by constructing trenches and sand storage dams.

Titus

Date of interview: 10th July 2006
Sexe: Male
Note: He is employee of WCT and his job is to manage the digging of trenches beside the Voi River. He is interviewed on the shamba of Josua Mshoke.

Why are only women digging the trenches?
The men of this area are very lazy and a lot of them are working in Mombasa. Women mainly dig the trenches. Some men also dug for a period, but now they're gone.

Do the farmers in the surroundings cultivate the land for a long time?
The farmers are not really agrarians. In the past they mostly did cattle breeding. So, they aren't very good and experienced farmers.

How do they get water for cultivating crops?
They use a water pump for flood irrigation. Because of that they can obtain water for almost the whole year. Excepting the months Augustus and September, because in these months the river is dry, then they

dig holes in the riverbed. So, they can still harvest some water. They plant crops during the whole year, while the farmers on the other side of the river without pump only harvest one or two times a year.

What do you think of the filling up of the reservoir behind the dam with sand?
I think that it is better that there isn't sand in the reservoir behind the dam. It is also better if the sun can't shine up the reservoir, because then a lot of water evaporates. When the reservoir is filled up with sand the river is smaller. After the rains there is too much water, so a lot of water flows through the river and over land. The river floods and streams over the plots. It causes a lot of erosion on the riverbanks and the topsoil of the plots flows into the river by the water.

Land capability Classification tables

Table.1 Land capability descriptions, United States system (Morgan, 1986: p.82)

Class	Characteristics and recommended landuse
I	Deep, productive soils easily worked, on nearly level land; not subject to overland flow; no or slight risk of damage when cultivated; use of fertilizers and lime, cover crops, crop rotations required to maintain soil fertility and soil structure.
II	Productive soils on gentle slopes; moderate depth; subject to occasional overland flow; may require drainage; moderate risk of damage when cultivated; use crop rotations, water-control systems or special tillage practices to control erosion.
III	Soils of moderate fertility on moderately steep slopes, subject to more severe erosion; subject to severe risk of damage but can be used for crops provided plant cover is maintained; hay or other sod crops should be grown instead of row crops.
IV	Good soils on steep slopes, subject to severe erosion; very severe risk of damage but may be cultivated occasionally if handled with great care; keep in hay or pasture but a grain crop may be grown once in five or six years.
V	Land is too wet or stony for cultivation but of nearly leve slope; subject to only slight erosion if properly managed; should be used for pasture or forestry but grazing should be regulated to prevent plant cover from being destroyed
VI	Shallow soils on steep slopes; use for grazing and forestry; grazing should be regulated to preserve plant cover; if the plant cover is destroyed, use should be restricted until cover is re-established.
VII	Steep, rough, eroded land with shallow soils; also includes droughty and swampy land; severe risk of damage even when used for pasture or forestry; strict grazing or forest management must be applied.
VIII	Very rough land; not suitable even for woodland or grazing; reserve for wildlife, recreation or watershed conservation.

Classes I–IV denote soils suitable for cultivation.
Classes V–VIII denote soils unsuitable for cultivation.

Table 2. Extra classifications for land capability classification. (Morgan, 1986: pp. 83, 85, 227)

Effective depth (m)[1]

1	Deep	More than 1.5m
2	Moderately deep	1 m to 1.5 m
3	Moderately shallow	50 cm to 1 m
4	Shallow	25 cm to 50 cm
5	Very shallow	Less than 25 cm

Physical characteristics of surface soil

t1	Slightly unfavourable conditions. The soil has a tendency to compact and seal at the surface and a good tilth is not easily obtained.
t2	Unfavourable physical conditions. Compaction and sealing of the surface soil are more severe. A hard crust forms when the bare soil is exposed to rain and sun and poor emergence of seedlings can severely reduce the crop. On ploughing large clods are turned up which are not easily broken.

Erosion

1	No apparent, or slight, erosion
2	Moderate erosion: moderate loss f topsoil generally and/or some dissection by run-off channels or gullies.
3	Severe erosion, severe loss of topsoil generally and/or marked dissection by run-off channels or gullies.
4	Very severe erosion: complete truncation of the soil profile and exposure to the subsoil (B-horizon) and/or deep and intricate dissection by run-off channels or gullies.

Table 3. Land capability class.

	I	**II**	**III**	**IV**
Permissible steepness of slope [2]	0º-1º	1º-2.5º	4.5º-7º	>7º and <30º
Minimum effective depth (m)	1-0.5	0.5	0.5-0.25	0.25
Physical characteristics of the surface soil – permissible symbols	Not permitted	t1	t1 and t2	t1 and t2
Erosion – permissible symbols	1	1 and 2	1,2 and 3	1,2 and 3

[1] The classification is based on Morgan (1986: pp. 83, 85, 227). Rough estimations of the ground layer thickness were done by using gullies, rock surfaces and estimations of local farmers. Several times, gullies were used to determine the depth of the rock layer, because it was visible in the gullies. A lot of gullies were deeper than 1.5 m, what made the estimation precise.

[2] The slope has to be less than 30º to fall in land capability class I-IV, because these slopes can be used for agriculture if mechanic soil conservation measures are taken (Morgan, 1986). The steepness of slopes is determined by slope measurements through the research area and calculation of the slopes based on contour lines. Measurements are used to control and improve the results of the last one. An inventory of steepness of slopes is presented in Map II (see Collective appendix, Maps)

Soil data

Table 4. British Soil Classification System for Engineering Purposes (Craig, 2004)

Soil groups			Subgroups and laboratory identification			
GRAVEL and SAND may be qualified sandy GRAVEL and gravelly SAND, etc., where appropriate			Group symbol	Subgroup symbol	Fines (% less than 0.06 mm)	Liquid limit
COARSE SOILS less than 35% of the material is finer than 0.06 mm	GRAVELS More than 50% of coarse material is of gravel size (coarser than 2 mm)	Slightly silty or clayey GRAVEL	GW G GP	GW GPu GPg	0 to 5	
		Silty GRAVEL Clayey GRAVEL	G–M G–F G–C	GWM GPM GWC GPC	5 to 15	
		Very silty GRAVEL Very clayey GRAVEL	GM GF GC	GML, etc GCL GCI GCH GCV GCE	15 to 35	
	SANDS More than 50% of coarse material is of sand size (finer than 2 mm)	Slightly silty or clayey SAND	SW S SP	SW SPu SPg	0 to 5	
		Silty SAND Clayey SAND	S–M S–F S–C	SWM SPM SWC SPC	5 to 15	
		Very silty SAND Very clayey SAND	SM SF SC	SML, etc SCL SCI SCH SCV SCE	15 to 35	
FINE SOILS more than 35% of the material is finer than 0.06 mm	Gravelly or sandy SILTS and CLAYS 35% to 65% fines	Gravelly SILT Gravelly CLAY	MG FG CG	MLG, etc CLG CIG CHG CVG CEG		<35 35 to 50 50 to 70 70 to 90 >90
		Sandy SILT Sandy CLAY	MS FS CS	MLS, etc CLS, etc		
	SILTS AND CLAYS 65% to 100% fines	SILT (M-SOIL) CLAY	M F C	ML, etc CL CI CH CV CE		<35 35 to 50 50 to 70 70 to 90 >90
ORGANIC SOILS		Descriptive letter 'O' suffixed to any group or subgroup symbol				
PEAT		Pt				

Table 5. Soil data for measurement points I1-I20.

Measurement point	Description in the field	Height ground dry (cm)	Fraction coarse sand (cm)	Fraction after mixing (cm)	Fraction after 1 hour (cm)	Fraction after 24 hour (cm)	Humus	Sand (%)	Silt (%)	Clay (%)	Stiffness of soil
I1	grey,loose,sandy clay	2,0	?	1,1	1,7	2,0	2	50	33	17	firm
I2	dark brown-red,compacted sandy clay	4,0	2,5	3,6	4,3	4,3	0	78	22	0	firm
I3	red,compacted clay	3,5	?	2,5	2,9	3,2	0	73	25	12	firm
I4	blacky,compacted clay	2,0	?	2,1	3,0	3,6	1	50	28	22	firm
I5	greyey,uncompacted clay	2,4	?	1,5	2,1	2,3	2	60	30	11	firm
I6	red,compacted clayey sand	2,4	?	2,0	2,6	2,9	3	63	24	13	firm
I7	red,compacted clay	2,2	?	2,0	2,7	2,9	0	63	29	9	firm
I8	red,compacted clay with a lot of humus	2,8	1,6	2,5	3,2	3,4	1	67	25	8	dense
I9	Black-grey,compacted clay	2,8	1,3	1,8	2,8	3,1	3	51	37	13	soft
I10	red,loose,clayey sand without humus	2,4	0,5	1,8	2,7	2,8	0	58	38	5	firm
I11 (eroded)	red,compacted clay without humus	2,5	0,6	2,4	2,8	2,9	0-1	78	17	4	very loose
I11 (uneroded)	red,compacted clay with a lot of humus	3,0	1,0	2,5	3,3	3,4	2	67	29	4	medium dense
I12	red compacted clay with a little humus	2,7	0,4	2,3	3,1	3,2	0-1	65	31	4	medium dense
I13	red,few compacted clay with a lot of humus	2,0	0,7	2,0	2,5	2,6	2	72	23	2	loose
I14	red,very compacted clay with a lot of humus	3,2	1,5	2,7	3,2	3,3	4	77	19	4	dense
I15	red,loose clay	3,5	0,0	2,8	4,3	4,4	1	54	43	3	soft
I16	greyey,loose clay with a little humus	3,2	1,2	2,5	3,5	3,6	4	62	34	4	soft
I17	red,cemented,clayey,coarse sand	3,2	1,2	3,1	3,4	3,5	2	85	11	4	firm
I18	greyey,compacted clay with a little humus and small stones	3,5	1,3	2,8	4,2	4,3	1	57	42	2	firm
I19	red,clayey,coarse sand with humus and small stones	3,7	0,5	3,3	4,4	4,5	2	65	32	3	very soft
I20	red,cemented sand with a little humus and small stones	3,6	0,5	2,9	3,9	4,2	0-1	60	30	10	soft

Table 6. Soil data for measurement points I21-I40.

Measurement point	Description in the field	Height ground dry (cm)	Fraction coarse sand (cm)	Fraction after mixing (cm)	Fraction after 1 hour (cm)	Fraction after 24 hour (cm)	Humus	Sand (%)	Silt (%)	Clay (%)	Stiffness of soil
I21	yellow-grey,clayey,stony sand with a little humus	3,4	1,3	3,4	3,9	4,1	0-1	77	16	7	firm
I22	red,loose,clayey sand	3,3	1,0	2,9	3,7	3,7	0	72	28	0	soft
I23	red,cemented sand with a lot of small stones	3,5	1,0	3,1	4,2	4,2	0-1	66	34	0	soft
I24	grey,loose sand with a lot of humus and small stones	3,1	1,5	3,1	3,3	3,4	2	88	8	4	soft
I25	browny,light cemented sand with a little small stones	3,5	0,8	3,0	3,7	3,9	1	70	23	7	soft
I26	browny,cemented,silty sand with humus and small stones	4,2	1,5	3,6	4,5	4,6	3	71	26	3	very soft
I27	red,cemented,silty sand with a lot of humus and a little small stones	4,1	0,5	3,2	4,4	4,5	2	63	35	2	firm
I28	grey-brown,compacted,sandy clay	3,6	1,1	2,9	4,1	4,3	0-1	61	37	2	firm
I29	brown,compacted,very sandy clay	4,1	1,5	3,3	4,6	4,7	0-1	61	36	3	soft
I30	grey-black,compacted,sandy clay	4,5	0,0	2,0	5,4	5,5	0	25	72	3	soft
I31	brown,compacted,sandy clay	4,1	0,3	1,8	4,6	4,6	2	29	71	0	soft
I32	red,uncompacted,very sany clay	3,7	0,8	2,4	4,2	4,2	0	47	53	0	soft
I33	brown,loose,very clayey sand	3,5	2,0	3,3	3,6	3,7	1	87	11	2	soft
I34	Black-grey,uncompacted,very sandy clay with humus	3,3	0,0	2,4	3,5	3,7	3	57	36	7	very firm
I35	red,cemented,very clayey sand with humus and a little small stones	3,1	1,0	2,5	3,6	3,7	1	60	37	4	firm
I36	red,compacted,very sandy clay with humus	3,1	0,7	2,7	3,7	3,8	1	63	33	4	soft
I37	brown,very compacted,very sandy clay with humus and small stones	4,0	0,9	2,5	4,1	4,2	1	51	48	2	soft
I38	dark brown, compaced, sandy clay with a little humus	4,0	1,4	3,1	4,7	4,8	0-1	54	43	3	soft
I39	grey-silverly, light cemented sand	2,6	0,5	2,6	3,1	3,3	0-1	73	19	8	very soft
I40	grey-silverly, light cemented sand	3,7	2,0	3,8	4,7	4,7	0	74	26	0	soft

Table 7. Infiltration data and soil description of measurement points I1-I20.

Measurement point	Infiltration time (s)/15mm	Tillage conditions	depth ground layer (m)	Stiffness of soil (official)	Colour	Stiffness of soil (tested)	Name	Addition	Abbreviation
I1	60	t1	0,1	uncompact	Greyish	firm	organic sandy SILT		MSO
I2	85	t2	>1.5	cemented	Dark brown-red	(firm)	very silty SAND		SM
I3	30	t2	>1.5	dense	Red	(firm)	very silty SAND		SM
I4	43	t1	>1.5	uncompact	Black	firm	organic sandy SILT		MSO
I5	50	t1	>1.5	uncompact	Grey	firm	organic sandy SILT		MSO
I6	127	t2	1-1.5	dense	Grey-black	(firm)	organic very silty SAND	with occasional small STONES	SMO
I7	90	t2	>1.5	compact	Red	firm	sandy SILT		MSO
I8	133	t1	unknown	compact	Red	dense	organic very silty SAND		SMO
I10	220	t2	>1.5	uncompact	Red	firm	sandy SILT		SM
I11 eroded	165	t2	1-1.5	slightly cemented	Red	(very loose)	organic very silty SAND		SMO
I11 uneroded	165	t2	1-1.5	slightly cemented	Red	(medium dense)	organic very silty SAND		SMO
I12	133	-	>1.5	slightly cemented	Red	(medium dense)	organic very silty SAND		SMO
I13	88	-	>1.5	loose	Red	(loose)	organic very silty SAND		SMO
I14	155	-	>1.5	cemented	Red	(dense)	organic very silty SAND		SMO
I15	136	-	>1.5	uncompact	Red	soft	organic sandy SILT		MSO
I16	59	-	>1.5	uncompact	Grey	soft	organic sandy SILT		MSO
I17	57	-	>1.5	cemented	Red	(firm)	organic silty SAND		SMO
I18	250	t2	unknown	compact	Grey	firm	organic sandy SILT	with some small STONES	MSO
I19	351	t2	unknown	compact	Red	very soft	organic sandy SILT	with some small STONES	MSO
I20	230	t2	0,5	compact	Red	soft	organic sandy SILT	with some STONES	MSO

Table 8. Infiltration data and soil description of measurement points I21-I40.

Measurement point	Infiltration time (s)/15mm	Tillage conditions	depth ground layer (m)	Stiffness of soil (official)	Colour	Stiffness of soil (tested)	Name	Addition	Abbreviation
I21	106	t1	0,1	loose	Grey-beige	(firm)	organic very silty SAND	with some STONES	SMO
I22	151	t1	>1.5	loose	Red	(soft)	very silty SAND		SM
I23	151	t2	>1.5	cemented	Red	(soft)	very silty SAND	with STONES	SM
I24	138	-	>1.5	loose	Grey	(soft)	organic silty SAND	with STONES	SMO
I25	143	t2	>1.5	cemented	Brown	(soft)	organic very silty SAND	with some STONES	SMO
I26	145	t2	>1.5	cemented	Brownish	(very soft)	organic very silty SAND	with occasional some STONES	SMO
I27	99	-	>1.5	compact	Red	firm	organic sandy SILT	with occasional some STONES	MSO
I28	237	t2	>1.5	compact	Grey-brown	firm	sandy SILT		MS
I29	37	t1	>1.5	compact	Brown	soft	sandy SILT		MS
I30	43	t2	>1.5	compact	Grey-black	soft	sandy SILT		MS
I31	92	t1	>1.5	compact	Brown	soft	organic sandy SILT		MSO
I32	177	-	>1.5	uncompact	Red	soft	sandy SILT		MS
I33	73	-	>1.5	loose	Brown	(soft)	organic silty SAND		SMO
I34	45	-	<1	uncompact	Grey-Black	very firm	organic sandy SILT		MSO
I35	189	t1	>1.5	cemented	Red	(firm)	organic very silty SAND	with occasional STONES	SMO
I36	539	-	>1.5	compact	Red	soft	organic sandy SILT		MSO
I37	184	t1	>1.5	compact	Brown	soft	organic sandy SILT	with STONES	MSO
I38	191	t1	>1.5	compact	Dark brown	soft	sandy SILT		MS
I39	52	-	>1.5	slightly cemented	Grey-silverish	(very soft)	very silty SAND		SM
I40	55	-	>1.5	slightly cemented	Grey-silverish	(soft)	very silty SAND		SM

Photo gallery

Land use

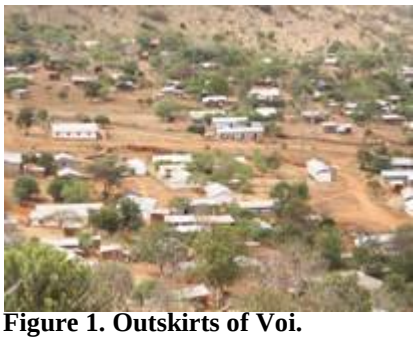


Figure 1. Outskirts of Voi.


Figure 2. Clay houses, Voi.


Figure 3. Mud road


Figure 4. Cattle keeping.


Figure 5. Agriculture.


Figure 6. Sisal estate


Figure 7. Bush; acacia shrub.


Figure 8. Tsavo East National Park.


Figure 9. Lion in Tsavo East.


Figure 10. Washing in Voi River.


Figure 11. Waste water plain, Voi


Figure 12. Irrigation water basin, orange estate.


Figure 13. Woman with firewood.


Figure 14. Charcoal burner.


Figure 15. Cutting firewood.

Figure 16. Sand harvesting Voi River.

Figure 17. Orange estate.

Soil erosion

Figure 18. Gully erosion

Figure 19. Gullies in the outskirts of Voi.

Figure 20. Very deep gully.

Figure 21. Overland flow erosion.

Figure 22. Rill erosion

Figure 23. Riverbank erosion by water.

Figure 24. Erosion induced by people and cattle.

Soil conservations measures

Figure 25. Small earth walls with brushes.

Figure 26. Riverbank protection near Voi.

Figure 27. Small terraces.

Figure 28. Planting of trees and grasses.

Figure 29. Vegtation.

Figure 30. Trenching with grass planting.

Water harvesting

Figure 31. Trenching.

Figure 32. Terracing.

Figure 33. Small earth walls.

Figure 34. Vegetation.

Figure 35. Sand storage dam.

Figure 36. Borehole.

Figuur 37. Irrigation.

Interviews

Figure 38. After interview writing down of the answers, F9, map 8.

Figure 39. Explaining what a terrace is, F10, map 8.

Figuur 40. Writing down all the names of the (women)group, F17,

Figure 41. Explaining the working of vetiver grass and bamboo as riverbank stabilizations, F7, map 3

Figure 42. Giving information about oranges and the sisal nursery, F6, map 3

Figure 43. Communication is sometimes a problem. Here school teachers of Ikanga primary are interpreting, F15, map 6

Figure 44. F1 explains his problems with soil erosion on his shamba, map 5.

Mountain-ranges

Figure 45. Sagala Hills.

Figure 46. Mwakingali Hills.

Figure 48. Small Taita Hills.

Figure 47. Small Taita Hills in front of the Taita Hills.