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AGRO-ECOLOGICAL ASSESSMENT OF LAND SUITABILITY IN SOME WESTERN DESERTIC FRINGES IN EL-GIZA GOVERNORATE, EGYPT.

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ABSTRACT

An agro-ecological land quality evaluation of land suitability in some Western Desertic Fringes in El-Giza Governorate was determined using the MicroLEIS IP (Integrated Package), which included the assessment of land suitability for different agriculture crops (Almagra model). The geo-spatial distribution of the soil suitability in the studied area indicate that the barren areas which observed in the mapping units of WP1, WP2, WP31 and WV with total area of about 1307.9 km^2 have marginal suitable areas (S4 and S5) for all selected crops and fruit trees due to its high content of coarse fragments, the excessively drainage condition and the high content of calcium carbonate and salts; except olive which has moderate suitable (S3) in these areas. On the other hand, the mapping units of WP32, WP33, AW11, AW12, AW21 and AW22 are cultivated areas with total area of about 311.14 km^2 and have high (S2) to moderate suitable (S3) to cultivate all selected crops and fruit trees. Moreover, the mapping units of AW11 and AW12 have the optimum suitable (S1) to cultivate cotton. Also, the human activities in these areas improved the soil quality and suitability to cultivate many crops.

INTRODUCTION

Horizontal expansion, as well as, vertical expantion, nowadayes in Egypt, there is urgently needed to meet with the current needs of food security.

The need for optimum use of land has never been greater than at present in Egypt, when rapid population growth and urban expansion are making available for agriculture a relatively scarce commodity.

The main goal of this study is to use the agro-ecological assessment of land suitability in some western desertic fringes in El-Giza governorate to determine the current suitability of these soils for different agriculture crops.

Description of The Studied Area

Climate

The study area is considered as semi-arid zone. The average climatic parameters over thirty year's period after the Economic Agricultural Research Institute (EARI, 2004) shows that the main annual temperature obtained from Badrashien, West Cairo and El-Giza are between 21.8, 20.4, 21 ^{0}C respectively. The differences between the mean summer and the mean winter temperature are more than 5 ^{0}C. The rain fall is nil through June, July, August and the evapo-transpiration reaches its maximum (195 mm/month) during this period. According to the American Soil Taxonomy (1999) the soil temperature regime could be classified as Thermic and the soil moisture regime as Torric.

Geology

According to Abu Al-Ezz (1971) the western desert plateau are formed of massive yellow limestone, chalky limestone, marl and shale of lower middle Eocene.

Said (1993) found that soils of the western side of the Nile valley covered by
Cretaceous, Eocene formations (limestone, clay and sands), Pliocene formations (gravels and sands) and found the Pliocene (River silts, sands, gravels) and Cretaceous (sandstone) in the alluvial colluvial zone.

Geomorphology

According to Abu Al-Ezz (1971) the western side of the valley is bounded by a plateau that spread over an extensive area of low to moderate relief. It is formed mainly of differently eroded Eocene limestone. Its eastern wall is steep and extends parallel to Nile Valley. It is dissected by a few tributaries that flow easterly towards the Nile. The plateau surface is marked by various erosional features on varied lithologic units within the Eocene bedrock that give variable color tones and drainage is poorly developed on the surface of the plateau.

Soils

El-Hamedy (1982), found that the soils of the alluvial wind borne deposits are stratified in the texture sandy in the parts close to the desert fringes and other parts are different in layers with the texture sandy to silty sand and sandy gravel. The total soluble salts ranges between 5.7 and 15.3 dS/m for the soils near the desert fringes and drop to 0.86-2.25 dS/m for the soils near the flood plain. The organic matter content ranges between 0.17 and 1.89%. The pH values range between 7.6-8.00% and $CaCO_3$ content ranges between 5.10 and 13.56%.

He also added that, the soil texture of the desertic deposits is sandy to sandy gravel. The total soluble salts ranges between 15.90 and 19.10 dS/m. The $CaCO_3$ content ranges between1.58 and 7.94%. The organic matter content is very low and less than 0.53%. The pH values range between 7.6 and 7.8. The soils could be classified as Torrifluvents, Torripsamments, Salorthids and Calciorthids.

Wahab et al. (1987) concluded that the western desert soils which are formed mainly of gravely sandy, calcareous and gypsiferrous materials, representing the interference zones between the alluvial soils and western desert firinges. These soils are recently under reclamation.

Land suitability

Land suitability is the fitness of a given tract of land for a defined use. Land suitability classification is based on four levels of generalization (FAO, 1985):

- Land Suitability Orders reflect kinds of suitability (i.e. Suitable and Not Suitable);
- Land Suitability Classes reflect degrees of suitability within Orders (i.e. S1, S2, S3, N1 and N2);
- Land Suitability Subclasses reflect kinds of limitation or kinds of inputs and improvements required within Classes (i.e. S2d, etc.);
- Land Suitability Units reflect minor differences in the required management within Subclasses (e.g. S2d-2, etc.).

MATERIALS AND METHODS

The study area is located beween El-Badrashin to El-Wasta area. It is bounded by longitudes 31^0 00' and 31^0 15' east and latitudes 29^0 15' and 30^0 00' north and its total area is about 1619.04 km^2.

To representative the soil of the area 13 soil profiles were chosen then dig and brief description in the filed then, the samples were collected according to the different in morphological features of soil profile layers to complete the laboratory analyses. Mechanically analyzed according to Piper (1950) ; the dry sieving according to Trask (1950), Calcium carbonate and Organic matter, Nelson (1982); The electric conductivity EC and the exchangeable cations, Soil Lab.Staff (1984); Cation exchange capacity, Goher (1954); calcium, magnesium, sodium and potassium according to Jackson (1967); (ESP) was calculated according to U.S.Salinity laboratory Staff (1945).

Soil taxonomy (1999), were used to classify the different soil profile. Then the soil correlation between the physiographic and the taxonomic units, were designed in order to identify the major soil units of the studied areas (Elberson and Catalon, 1987).

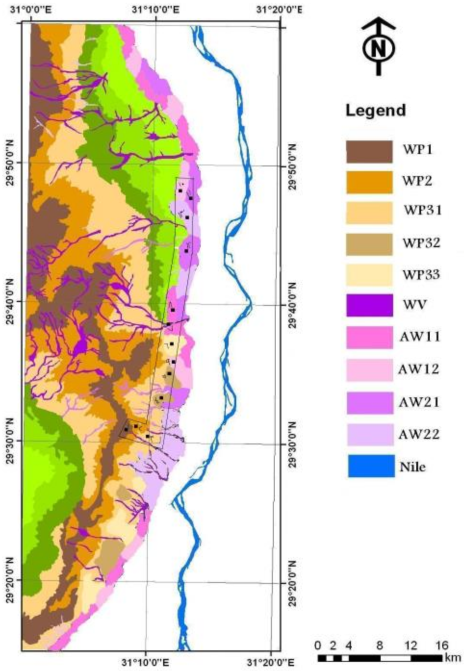
The MicroLEIS model (de la Rosa *et al.,* 2000) follow the criteria proposed by FAO (1976, 1985) and Sys,*et.al*.(1993) for land evaluation. According to that five suitability classes were established. Following the maximum limitation method which is used in MicroLEIS, each of the previously mentioned soil criterion has a definite action and role in agriculture production and the verification of the degree of a single variable is sufficient to classify the soil in the corresponding category. Thus, it is not necessary that all the classification factors are present in each class (Cardoso, 1970).

RESULTS AND DISCUSSION

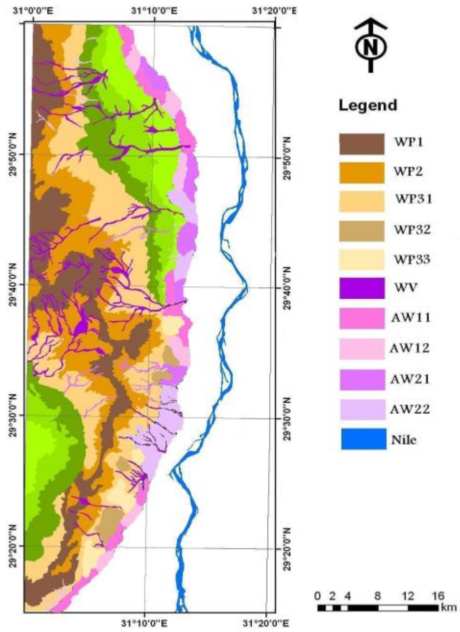
The field work have been planned as shown in map (1) and the detailed morphological descriptions were recorded using the FAO guidelines (1990).The Physiographic map legend are shown in map (2) and table(1), and the physical and chemical analyses are shown in tables (2)

The Physiographic map of the area included the units WP1, WP2, WP31, WP32, WP33, WV, AW11, AW12, AW21 and AW22 and these areas are248.49, 291.59, 728.92, 21.61, 23.72, 110.65, 44.2, 35.32, 73.1 and41.19 km^2 , respectively, some units are barren and the others are cultivated.

The barren units are WP1, WP2, WP31 and WV. The elevation of these areas ranges between 70 to 90 m. These areas have gently undulating to moderately steep slope and its drainage condition is excessive. Soil color in dry is very pale brown (10YR7/4); and Yellowish brown (10YR5/6) in the moist condition.



Map 1: Soil sample area



Map 2: The physiographic and soil map

Table 1: Physiographic and Soil map legend of the studied area

Deposition Environmental	Landscap	Relief	Land form	Phase	Mapping unit	Area km2	Area %
Western Desertic Deposits	Western plateau	Summit	Flat Summit	Barren	WP 1	248.49	5.68
		Steep Slops	Steep Slops	Barren	WP 2	291.59	6.67
		Slops	Slops	Barren	WP 31	728.92	16.67
				Cultivated with crops	WP 32	21.61	0.49
				Cultivated with crop and orchards	WP 33	23.72	0.54
	Dry valleys	Main dry valleys	Undulating	Barren	WV1	88.12	1.86
		Secondary dry valleys	Gently undulating	Barren	WV2	12.4	0.26
		Small dry valleys	Almost flat	Barren	WV3	10.02	0.21
	Wind born formation	Alluvial-windborn deposits	Relatively high parts	Cultivated with crops	AW 11	44.2	1.01
				Cultivated with crop and orchards	AW 12	35.32	0.81
			Relatively low parts	Cultivated with crops	AW 21	73.1	1.67
				Cultivated with crop and orchards	AW 22	41.19	0.94

The dominant texture is sandy in the upper; sandy granules and sandy gravel in the middle and lower layers. CaCO3 content ranges between (13.56 to 18.80) % in the in the upper; and (10.13 to 19.77) % in the lower layers. Organic matter content is not exceeding 0.19% in the different layers. Soil salinity revealed that the electrical conductivity ranges between (6.37 to 8.31) dS/m in the upper; and(5.27 to7.95) dS/m in the middle and lower layers. pH values ranges between (7.48 to7.56). Cation exchange capacity (CEC) ranges between (5.15 to7.41) meq/100g soil in the upper; and(4.45 to 7.25)meq/100g soil in the lower layers. The exchangeable sodium percentage (ESP) values ranges between (12.04 to14.19) %in the upper; and (11.02 to14.20) % in the lower layers. Based on the American Soil Taxonomy System (1999) these soils classified as Torripsamments.

The cultivated units are WP32, WP33, AW11, AW12, AW21 and AW22. The elevation of these areas ranges between 60 to 75 m. These areas have nearly level to gently undulating slope and its drainage condition is well to moderately well. Soil color in dry is brownish yellow (10YR6/8); and Yellowish brown (10YR5/8) in the moist condition

The dominant texture is sandy and sandy clay loam in the upper; sandy clay loam, loamy sand, sandy loam in the middle and lower layers. CaCO3 content ranges between (3.16 to 9.18) % in the upper; and (4.42 to13.51)% in the lower layers. Organic matter content is not exceed 1.62% in the upper layers and tends to decrease with depth to reaches the value of 0.26% in the lower layers. Soil salinity revealed that the electrical conductivity ranges between (1.15 to2.37)dS/m in the upper; and(1.37 to9.45)dS/m in the middle and lower layers. pH values ranges between (7.22 to7.94). Cation exchange capacity (CEC) ranges between (10.37 to35.8)meq/100g soil in the upper; and(4.14 to30.52)meq/100g soil in the lower layers. The exchangeable sodium percentage (ESP) values ranges between (3.61 to6.09)%in the upper; and (6.4 to14.49)% in the lower layers. Based on the American Soil Taxonomy System (1999) these soils classified as Torrifluvents and Torripsamments.

Agricultural land suitability

The Pro&Eco Model was used to product land suitability for some common crops cultivated in the studied area including: wheat, maize, melon, potato, soybean, cotton, sun flower, sugar beat, alfa alfa, peach, citrus and olive. The obtained results as shown in table (3) reveal the following:

The mapping units of WP1 and WP2 have an area of 248.49, 291.95 km^2, respectively. They have moderate suitable to cultivate olive, marginal suitable to cultivate peach and citrus and not suitable for the other crops. They are not suitable because of its higher content of coarse fragments, the excessively drainage condition and the high content of calcium carbonate and salts. Also, these areas are barren.

The mapping unit of WP31 has an area of 728.92 km^2. It has moderate suitable to cultivate olive, marginal suitable to cultivate the other crops and fruits because of high content of coarse fragments, the high content of calcium carbonate and salts. However, These areas are not cultivated.

The mapping unit of WP32 has an area of 21.61 km2. It has high suitable to cultivate peach, citrus and olive; moderate suitable to cultivate the other crops due to the coarse texture and the high content of calcium carbonate and salts. These areas cultivated with crops but after this study we prefer to cultivate it with fruit trees.

The mapping unit of WP33 has an area of 23.72 km2. It has moderate suitable to cultivate all crops and fruits because of the coarse texture, the high content of calcium carbonate and salts. These areas cultivated with crops and fruit trees.

The mapping unit of WV has an area of 110.54 km2. It has moderate suitable to cultivate olive and marginal suitable to cultivate the other crops and fruits because of the high content of coarse fragments and the high content of calcium carbonate and salts. These areas are barren.

The mapping units of AW11 and AW12 they have an area of 44.20, 35.32 km^2 , respectively, and totally 79.52 km^2. They have the optimum suitable to cultivate cotton, high suitable to cultivate the other crops and fruits due to its high soil quality.

The mapping units of AW21 and AW22 they have an area of 73.10, 41.19 km^2, respectively, with total area of about 114.29 km^2. they have high suitable to cultivate cotton, moderate suitable to cultivate olive and the other crops, marginal suitable to cultivate peach and citrus trees because of the rising of the water table and increase in salts in these parts, moreover, the moderately high content of calcium carbonate.

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Conclusion

The cultivated areas of the study area showed healthier soil quality than the barren one. These results manifested the impact of human activity on the ecosystem and its power to convert unstable areas to usable. There is a great need to improve irrigation and drainage systems to increase land suitability for crops and fruit trees in the study area. Human impact on the ecosystem and incorporating indigenous knowledge must be considered if any sustainable development have to be successful.

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تقييم زراعي بيئـي لتقديرمـدى ملائمـه الارض للزراعـه بـبعض المنـاطق الصـحراويـه الغربية المتاخمة بمحافظه الجيزة

فؤاد حنا سليمان ، علي عبد الحميد عبد الهادي و عبير عبد رب النبي علوان
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تـم عمـل تقيـيم زراعـي بيئـي لتقديرمـدى ملائمــه الارض للزراعــه بـبعض المنــاطق الصـحراويه المتاخمـه بمحافظـه الجيـزه باسـتخدام برنـامج MicroLEIS IP (Integrated Package) . وقد اوضـحت النتـائج ان المنـاطق الغيـر منزرعـه و الممثلـه بالوحدات WP1 , WV, WP31,WP2 و اجالي مساحتها يقدر بحوالي 1307.9 كم^2, فوجدت حديه الملائمه (S4 and S5) لزراعه المحاصيل المختاره ويرجع السبب في ذلك الى ارتفاع نسبه الحصـى بالإضـافه الى ارتفاع محتواها من الاملاح أما زراعه الزيتون فتعبر متوسطه الملائمـه فـي هذه الوحـدات. أمـا المنـاطق المنزرعـه و الممثلـه بالوحدات WP32 ,WP33, AW11, AW12, AW21 , AW22و إجمـالي مسـاحتها حـوالي 311.14 كـم^2, ذات ملائمــه عاليـه إلـي متوسـطه لزراعـه المحاصيل المختاره بالإضـافه الـى ان الوحدات AW11, AW12 وجدت ذات ملائمـه عاليـه جدا لزراعه القطن. وقد عمل النشاط البشري في هذه المناطق على تحسين الخواص الطبيعية والكيماويـة و الذي انعكس علي تحسين ملائمه هذه الاراضـي للزراعات المختلفه.

Table2: Soil physical and chemical analyses

Mapping unit	Profile No.	Depth (cm)	Gravel %	Textur classes	CEC meq/100g soil	Exchangeable Cations meq/100g soil				ESP	OM %	pH	EC (ds/m)	CaCO3%
						Ca++	Mg++	Na+	K+					
WP1	**1**	**0 - 45**	10.78	S	6.95	3.44	1.62	0.84	0.42	12.09	0.12	7.7	6.37	17.36
		45 - 140	31.17	S.g	4.65	2.6	0.89	0.54	0.45	11.61	0.16	7.65	5.27	15.62
WP2	**2**	**0 - 70**	17.82	S	5.15	2.84	0.91	0.62	0.48	12.04	0.14	7.84	7.75	14.62
		70 -130	29.88	S.g	4.45	2.29	0.98	0.57	0.38	12.81	0.19	7.81	7.91	13.86
WP31	**3**	**0 - 25**	13.67	S	7.41	3.85	2.13	0.94	0.23	12.69	0.13	7.72	6.48	13.56
		25 - 60	17.08	S	7.25	3.73	2.05	0.93	0.32	12.83	0.12	7.84	6.86	12.28
		60 - 75	24.31	S	5.42	3.31	0.95	0.62	0.34	11.44	0.11	7.58	7.52	10.13
		75 - 120	41.49	S.g	4.81	3.14	0.84	0.53	0.24	11.02	0.08	7.56	7.95	11.24
WP32	**4**	**0 - 20**	3.76	S	13.12	7.76	3.46	0.74	0.96	5.64	1.13	7.29	1.37	7.52
		20 - 40	14.17	S	10.37	5.96	2.59	0.82	0.78	7.91	0.59	7.55	3.5	10.44
		40 - 70	26.79	S.g	7.88	4.38	1.74	1.08	0.46	13.71	0.32	7.72	5.81	12.32
		70 - 120	35.76	S.g	6.18	3.61	1.39	0.87	0.22	14.08	0.28	7.91	8.63	11.81
	5	**0 - 20**	1.86	S	11.82	6.56	3.5	0.72	0.89	6.09	1.05	7.22	2.37	9.18
		20 - 55	12.76	S	10.93	6.17	2.94	1.02	0.65	9.33	0.81	7.68	4.52	11.77
		55 - 80	16.07	S	10.32	6.68	1.89	1.17	0.49	11.34	0.32	7.71	7.41	13.26
		80 - 120	24.09	S.g	6.66	4.82	0.48	0.85	0.35	12.76	0.26	7.79	8.65	13.51

Table 2. Continued

Mapping unit	Profile No.	Depth (cm)	Gravel %	Texture classes	CEC meq/100g soil	Exchangeable Cations meq/100g soil				ESP	OM %	pH	EC (ds/m)	CaCO3%
						Ca++	Mg++	Na+	K+					
WP33	**6**	**0 - 20**	2.33	S	10.69	5.75	3.38	0.57	0.79	5.33	1.13	7.33	1.38	6.87
		20 - 50	15.23	S	8.2	4.06	2.87	0.64	0.53	7.8	0.62	7.47	5.71	7.55
		50 - 75	22.96	S	5.32	2.83	1.47	0.51	0.4	9.59	0.43	7.61	7.11	9.28
		75 - 110	37.67	S.g	4.14	2.48	0.69	0.6	0.31	14.49	0.27	7.94	9.45	11.12
WV	**7**	**0 - 40**	20.2	S	5.85	3.38	1.26	0.83	0.29	14.19	0.12	7.8	8.31	18.9
		40 - 110	42.84	S.G	4.79	2.65	1.09	0.68	0.28	14.2	0.12	7.8	7.92	19.77
AW11	**8**	**0 - 20**	0	S.C.L	34.77	23.8	6.81	2.08	1.32	5.98	1.44	7.23	1.15	3.72
		20 - 40	0	S.C.L	30.18	20.22	5.86	2.64	1.08	8.75	0.79	7.44	1.37	5.18
		40 - 55	0	S.L	21.7	15.75	2.71	2.14	0.73	9.86	0.51	7.63	2.91	5.75
		55 - 85	0	S	8.57	4.84	1.89	0.89	0.61	10.39	0.3	7.61	3.52	6.26
		85 - 120	0	S	5.22	2.53	1.31	0.66	0.52	12.64	0.26	7.88	3.97	6.67
AW12	**9**	**0 - 20**	0	S.C.L	24.41	18.36	3.42	0.88	1.34	3.61	1.57	7.21	1.21	3.87
		20 - 50	0	S.L	10.32	7.53	1.63	0.66	0.28	6.4	0.72	7.38	3.48	5.56
		50 - 70	0	L.S	8.38	5.28	1.51	0.81	0.54	9.67	0.55	7.51	3.81	8.53
		70 - 110	0	S	5.64	2.97	1.52	0.64	0.21	11.35	0.36	7.71	4.35	8.82
	10	**0 - 20**	0	S.C.L	35.8	25.21	7.26	1.67	1.03	4.66	1.61	7.35	1.33	3.16
		20 - 70	0	S.C.L	30.52	21.73	5.54	2.18	0.67	7.14	0.55	7.52	3.16	4.42
		70 - 90	0	S.L	18.14	11.66	3.53	2.04	0.81	11.25	0.36	7.81	4.86	6.18
		90 - 130	0	S	4.63	2.46	1.25	0.54	0.32	11.66	0.27	7.87	5.88	6.29
AW21	**11**	**0 - 20**	0	S.C.L	32.21	23.28	5.24	2.27	1.05	7.05	1.62	7.51	3.81	2.63
		20 - 50	0	S.C.L	38.72	25.96	7.68	4.21	0.82	10.87	0.83	7.67	5.18	5.41
		50 - 75	0	S.C.L	25.72	18.16	3.32	3.67	0.41	14.27	0.55	7.93	8.64	6.94
	12	**0 - 25**	0	S.C.L	30.68	20.89	5.75	2.08	1.79	6.78	1.43	7.36	3.28	3.38
		25 - 45	0	S.C.L	36.33	23.31	7.28	3.61	1.91	9.94	0.63	7.64	6.58	4.66
		45 - 75	0	S.C.L	27.63	18.38	4.16	3.78	1.44	13.68	0.32	7.73	7.16	6.23
AW22	**13**	**0 - 30**	0	S.C.L	23.81	15.62	5.06	1.65	1.14	6.93	1.07	7.48	2.16	3.81
		30 - 60	0	S.C.L	26.42	17.94	4.65	2.74	1.04	10.37	0.4	7.55	5.97	6.96
		60 - 100	0	S.C.L	21.24	13.58	3.74	3.06	0.66	14.41	0.26	7.81	7.13	8.28

Table 3 . Current land suitability for the crops in the different mapping units.

Mapping Unit	sun flower	alfa alfa	potato	soybean	wheat	maize	melon	cotton	sugarb.	peach	citrus	olive
WP1	S5tdcsa	S5tdcsa	S5tdsa	S5tdcsa	S5tdcsa	S5tdsa	S5tdsa	S5td	S5tdc	S4tdsa	S4tdsa	S3tdcsa
WP2	S5tdcsa	S5tdcsa	S5tdsa	S5tdcsa	S5tdcsa	S5tdsa	S5tdsa	S5td	S5tdc	S4tdsa	S4tdsa	S3tdcsa
WP31	S4tcsa	S4tcsa	S4tsa	S4tcsa	S4tcsa	S4tsa	S4tsa	4t	4tc	S4tsa	S4tsa	S3tcsa
WP32	3tcs	S3ts	3tcs	S3ts	S3ts	3tcs	3tcs	3tc	3t	S2tcs	S2tcs	S2ts
WP33	S3tcsa	S3tcsa	S3tsa	S3tcsa	S3tcsa	S3tsa	S3tsa	3t	3tc	S3tsa	S3tsa	S3tcsa
WV	S4tsa	S4tsa	S4tcsa	S4tsa	S4tsa	S4tcsa	S4tcsa	S4tcs	S4ts	S4tcsa	S4tcsa	S3tsa
AW11	S2tca	S2tca	S2a	S2tca	S2tca	S2ta	S2a	S1	S2tc	S2a	S2a	S2ca
AW12	S2tca	S2tca	S2a	S2tca	S2tca	S2ta	S2a	S1	S2tc	S2a	S2a	S2ca
AW21	S3tcsa	S3tcsa	S3sa	S3tcsa	S3tcsa	S3tsa	S3sa	S2s	3tcs	S4dsa	S4dsa	S3dcsa
AW22	S3tcsa	S3tcsa	S3sa	S3tcsa	S3tcsa	S3tsa	S3sa	S2s	S2tcs	S4sa	S4sa	S3csa