Soil Test Interpretation Guide (for A&L soil analysis reports)

1. The first thing to look at is the pH and the Buffer Index. If the Buffer Index is blank, then there is no need for lime. If the value in the Buffer Index box is less than 7.0, then consult the "Tons/Acre Limestone" table on the back the analysis report. If the pH is greater than 7.0, you may need to acidify the soil (see number 3). Generally, most crops do not need lime if the soil pH (not the buffer pH) is 6.2 or higher. There are many exceptions though and the ideal pH for certain crops in specific regions may vary. In general, if the soil pH is below 6.2, lime applications can be determined by multiplying the acidity value (in meq/100g H (hydrogen)) by 0.65, 0.75 for crops requiring a soil pH of 6.5 to 7.0.

2. After determining how much lime to apply, you need to determine the type of lime needed. To do this, divide the value in the "CALCIUM" (Ca) box by the value in the "MAGNESIUM" (Mg) box. If the result is less than seven, then you should apply only calcium lime. If the result is more than 10, you should apply only dolomite lime (contains both Ca and Mg). If the result is in between 7 and 10, look at the Mg and Ca values and note the letters immediately following the numbers. If the letters in the Mg box are VL, and the letters in the Ca box are M, H, or VH, then dolomite should be applied. In all other scenarios, use calcium lime. Most calcium lime in the Northeast contains 3-5 percent Mg so some Mg is always being applied.

3. If the pH indicates a severely alkaline condition (7.5 or higher), you may want to consider adding elemental sulfur to your soil. Use the table below to determine the amount of sulfur to apply.

   LOWERING pH WITH ELEMENTAL SULFUR

   Expressed in # per 1000 square feet

	DESIRED pH				
PRESENT pH	6.50	6.00	5.50	5.00	4.50
8.00	27	36	50	63	72
7.50	18	32	41	54	63
7.00	9	18	32	45	54
6.50		9	23	36	41
6.00			9	23	32

   NOTE: Reduce rates by one-third for sandy soils
   Increase rates by one-half for clay soils

   Unless the application of sulfur is being thoroughly incorporated into the soil, it is not recommended that more than 20#/1000ft^2 are applied at one time.

   Sulfur bacteria use sulfur as energy and create sulfate ions (SO_4). Sulfate mixes with water to create sulfuric acid, which reacts with carbonates in the soil to make carbon dioxide and water. Removal of carbonates lowers pH. Soil temperature has to be above 60^o for these reactions to occur because sulfur bacteria are inactive below that temperature.

4. Look at the values in the "POTASSIUM (K)," "MAGNESIUM (Mg)," and "CALCIUM (Ca)" boxes and see if any of the values are labeled "VL" (very low) or "L" (low). If any are labeled low, look at the PERCENT BASE SATURATION boxes and compare those values with the following ranges.

   - K 2-5%
   - Mg 10-15%
   - Ca 65-75%

   If your values fall within those ranges, then the low rating is not a major concern. Also, don't worry if your values are above those ranges. If the values are labeled VL, or fall below the base saturation ranges above, K, Ca, or Mg may need to be added. The value in the box marked "CEC" is required to determine the amount of the elements needed. When you've found the CEC, round it to the nearest whole number and use the table below to determine the ideal values of K, Ca, and Mg.

CEC	POTASSIUM (CEC x 390 x %) 2-5%	MAGNESIUM (CEC x 120 x %) 10-15%	CALCIUM (CEC x 200 x %) 65-75%
30	292	360	3900

CEC	POTASSIUM (CEC x 390 x %) 2-5%	MAGNESIUM (CEC x 120 x %) 10-15%	CALCIUM (CEC x 200 x %) 65-75%
29	284	348	3770
28	274	336	3640
27	264	324	3510
26	254	312	3380
25	244	300	3250
24	234	288	3120
23	224	275	2990
22	215	263	2860
21	205	252	2730
20	195	240	2600
19	192	236	2470
18	187	230	2340
17	182	225	2210
16	176	218	2080
15	170	210	1950
14	164	202	1820
13	158	193	1690
12	152	183	1560
11	147	172	1430
10	141	160	1300
9	135	148	1170
8	129	135	1040
7	123	121	910
6	117	106	708
5	108	90	650
4	85	75	520
3	81	70	500
2	67	54	330

For example, if your CEC is 7.2, round the CEC to 7 and find the row in the table where 7 is in the first column. Notice that the ideal values for K, Mg, and Ca are 123, 121, and 910 respectively. Compare the ideal values to values on your report.

Another way to calculate the level needed is to use these formulae:

- For K, CEC X 390 X %*
- For Mg, CEC X 120 X %*
- For Ca, CEC X 200 X %*

*Percent of saturation desired

Subtract the values on your report (if they are lower) from the ideal values to determine the amount of nutrients needed. Now let's deal with each element separately.

5. Potassium or K is expressed in parts per million (PPM) of the actual element on the analysis report but fertilizers measure potassium as potash (K_2O) and application rates are usually expressed in pounds per acre (PPA) or per 1000 ft^2 (PPTSF). To convert K expressed in ppm to K_2O expressed in PPA, multiply the PPM value by 2.4. To convert the value expressed in PPA to PPTSF divide PPA by 43.56. Once you have determined the amount of potash per acre or per thousand square feet, you'll need to decide what product you're going to use to supply the needed potash. North Country Organics has four products that supply potash. To calculate the amount of material needed, divide the PPA or PPTSF needed by the percent value in the right column of the table below. *Remember*, the percent value is in hundredths, so 52 percent = 0.52, 22 percent = 0.22, etc.

Product	Percent soluble potash
Natural sulfate of potash	52
Natural sulfate of potash, magnesia	22
Greensand Plus	17
Greensand	0 soluble, 6 insoluble

Note: Greensand will slowly build reserves of potash but will not satisfy an immediate need. Natural sulfate of potash, magnesia also contains 11 percent magnesium and should not be used unless the analysis report indicates a deficiency in Mg.

6. Magnesium is also express in PPM on the analysis report. To convert Mg expressed in PPM to PPA, multiply by 2. To convert PPA to PPTSF, divide by 43.56. Mg can be supplied by dolomite lime but if the pH is in the desired range, lime should not be used. North Country Organics has three products that supply Mg. To calculate the amount of material needed, divide the PPA or PPTSF needed by the percent value in the right column of the table below. *Remember*, the percent value is in hundredths, so 10 percent = 0.1, 11 percent = 0.11, etc.

Product	Percent magnesium
Epsom salts (magnesium sulfate)	10
Natural sulfate of potash, magnesia	11
Magnesium oxide	60
Note: Magnesium oxide is not allowed on certified organic farms in most States.	

7. Like Mg and K, Ca is also expressed in PPM on the analysis report. To convert Ca expressed in PPM to PPA, multiply by 2. To convert PPA to PPTSF, divide by 43.56. Ca can be supplied by both dolomite and calcium lime but if the pH is in the desired range, lime should not be used. North Country Organics has five products that supply Ca. To calculate the amount of material needed, divide the PPA or PPTSF needed by the percent value in the right column of the table below. *Remember*, the percent value is in hundredths, so 10 percent = 0.1, 11 percent = 0.11, etc.

Product	Percent calcium
Aragonite	38
Calcium limestone flour	38
Gypsum	23
Basic slag	29
Phosphate rock	34
Note: Aragonite, Calcium limestone flour, Basic slag, and even Phosphate rock (to a certain extent) will raise the pH of the soil. Gypsum is the only product that will add calcium to the soil without affecting the pH. Phosphate rock should only be used if the analysis report also indicates a need for phosphorus.	

8. Phosphorus is calculated differently than K, Mg, and Ca because it has opposite ionic properties and is not related to the CEC. A&L tests for both available (Bray P1) and reserve (Bray P2). Adequate levels of available phosphorus are between 22 and 33 PPM. Reserve levels should be between 34 and 51 PPM. If the results indicated on your analysis report are below these ranges, then applications of phosphorus should be considered. Phosphorus is applied as phosphate in fertilizers (expressed as P_2O_5). To convert phosphorus expressed in PPM to phosphates in PPA, multiply by 4.6. For example, if you need 20 PPM phosphorus, 20 X 4.6 = 92 PPA of phosphate. North Country Organics has three products that supply phosphate. To calculate the amount of material needed, divide the PPA or PPTSF needed by the percent value in the right column of the table below. *Remember*, the percent value is in hundredths, so 40 percent = 0.4, 12 percent = 0.12, etc.

Product	Percent available phosphate
Phosphate rock	3-7 avail. 30 total
Precipitated bone meal	40
Steamed bone meal	11-13
Note: The total amount of phosphate in phosphate rock is eventually released in 4-6 years depending on the climate, pH, and the overall health of the soil. Precipitated bone meal has the most available phosphate but the product's consistency is very fine and can be difficult to work with. Steamed bone meal has a better consistency and has 5 percent nitrogen but is expensive to use on a large scale.	

9. Now look at the box titled ORGANIC MATTER (OM). An ideal range for northeastern U.S. mineral soils is from 5 to 15 percent. As the level of OM is reduced below 5 percent, many of the soil's natural and beneficial functions begin to diminish. Soils with OM below 3 percent may perform fine in ideal

conditions; however, they have a more difficult time holding nutrients and water. Soils with very low OM cannot support the populations of beneficial organisms needed for very important functions that both feed and protect plants. OM levels are not easy to change. Each percent of OM in the top six inches of soil is about 20,000 pounds of stable humus. Creating, let alone replacing, stable humus is a monumental task. Compost can be added before and after the growing season, but if it isn't incorporated into the soil, no more than ½ inch should be applied at a time. ½ inch of compost on an acre of soil is equivalent to 69 yards so it may not be a practical solution. There are steps that one can take to increase the production and reduce the depletion of OM.

- Reduce the amount and the depth of tillage. Tillage fractures OM and introduces excessive oxygen, which hastens the decomposition of OM.
- Rotate crops. Row crops should be rotated with sod crops periodically.
- Grow cover crops or green manure.

Levels of OM above 15 percent are extremely rare in the Northeast. The major problem associated with very high OM is drainage. Drainage systems can be employed and course sand can be incorporated into the soil.

When you have determined what is needed to correct the deficiencies or imbalances shown on the soil analysis report, you need to determine the best time to apply these materials. Use the table below as a guide. Note: If heavy equipment is used to apply these materials, avoid applications when the soil is very wet. Soils are very prone to compaction when they are saturated with water.

Apply anytime	**Apply spring, summer, or early fall**
Aragonite, Basic slag, Calcium limestone flour, Greensand, Gypsum, Phosphate rock.	Epsom salts, Greensand Plus, Magnesium oxide, Natural sulfate of potash, Natural sulfate of potash, magnesia, Sulfur.

Note: Once you have applied all the necessary materials, you have only corrected the deficiency or imbalance. You still need to apply nutrients for crop removal (i.e., to replace the nutrients removed from the soil by crops) if you are to maintain a balanced base fertility.