MAINE DEPARTMENT OF AGRICULTURE
FOOD AND RURAL RESOURCES
OFFICE OF THE STATE SOIL SCIENTIST
STATE HOUSE STATION # 28
AUGUSTA, MAINE 04333
PHONE: (207) 287-2666
E-MAIL: DAVID.ROCQUE@MAINE.GOV

To: Fred Todd, Senior Planner, LURC
From: David P. Rocque, State Soil Scientist
Re: Proposed Bowers Wind Project
Date: April 6, 2011

After reviewing the subject application, I offer the following comments:

General – There are a couple of general comments I have regarding the design of this proposed wind farm project. The first comment concerns proposed road building techniques. The standard detail sheet only includes cross sections for roads built of compacted gravel which appears to be an indication that it will be the only road building technique used. Roads built of soil and gravel will require longer fill extensions than roads built with a blast rock base which can be an issue on steep side slopes and along ridge tops. The vast majority of cuts proposed for this project are along the ridge top crane paths which are comprised mostly of shallow to bedrock soils. That should provide an ample supply of blast rock for road building in sensitive areas and for turbine pads. It is my opinion that the design should be more specific and require the use of a blast rock road base, at a minimum, in sensitive areas such as on steep side slopes, along ridge tops and where road cuts are proposed to extend to or below the projected seasonal groundwater table. Blast rock roads on steep slopes reduce the downslope fill extension foot print thereby minimizing the extent of alteration required to build those roads. Blast rock roads, along with rock sandwiches, allow for pass through of intercepted groundwater thereby minimizing the alteration of the natural hydrology. I also believe that blast rock should be used for turbine pads. Doing so provides a sound base, allows for infiltration of stormwater and minimizes downslope fill extensions. Therefore, the standard details sheet should include details for blast rock roads, blast rock crane paths and blast rock turbine pads.

My second general comment concerns the use of rock sandwiches. The project design appears to only propose the use of a single rock sandwich with a second, potential, site which includes the note ”possible rock sandwich”. While I do agree that this project will likely need fewer rock sandwiches than most other wind farm projects because of existing access roads and few wetlands or steep side slopes to be crossed with road cuts, a single one with a second possibility is probably not going to be sufficient. For instance, Dill Hill Road, station 52+00 to 62+00 crosses over Telos, Monarda and Burnham soils and station 68+00 to 73+00 crosses a Telos soil with a cut and has a proposed turnout. New roads that cross very poorly or poorly drained soils should have a rock sandwich. Also, new roads that cross somewhat poorly drained soils with a cut on one side and fill on the other side are also likely candidates for a rock sandwich. I recommend that these areas also be identified on the plans as either needing a rock sandwich (poorly and very poorly drained soils) or are a probable candidate for a rock sandwich (Telos, Elliotsville swp variant, Colonel, Monson swp variant). Verification of the need for these rock sandwiches and their extent can be determined and/or adjusted in the field based on site specific decisions by the project engineer, contractor and third party inspector. It may also be advisable to use rock sandwiches in some locations as existing access roads are upgraded. I offer my assistance in making those decisions and would be interested in accompanying the third party inspector periodically as I did on Kibby and the Stetsons.

Specific Comments:

1. Proposed road ditch contours appear to directly connect into the few streams shown on the plans. Doing so can result in sediment and/or other pollutant discharges into streams which is not appropriate. It is important that road ditches have turnouts to filter out sediment or cross culverts to direct ditch water away from streams and not be allowed to discharge directly into them. Therefore, I recommend that the plans be revised to indicate that ditch turnouts are to be installed prior to reaching any stream. It would also be a good idea to include a general construction note and a note on the ditch turnout detail specifying that ditch turnouts or cross culverts are to be used prior to any ditch reaching a stream. Since it is likely that there are at least a few small intermittent streams not shown on the plans, the note would provide assurance that ditch water would not be allowed to directly discharge into any stream. Road ditch contours should also be revised to show that ditches empty into all cross culverts within them that don't discharge directly into a stream. Ditch berms are the preferred technique to prevent water in ditches from by-passing culverts which could result in the water overwhelming the road ditch before it finally is discharged.
2. Stormwater Berms – The design plans indicate occasional use of stormwater berms to direct runoff water to a specified location for discharge. In the case of a road ditch where water is to be directed to a ditch turnout, such berms are appropriate. I do not however, believe there is a need to concentrate runoff water for a longer time and distance to reach a specific buffer area if the area it is being directed away from is also suitable for filtering it. Such berms need to be maintained to work for the long term whereas allowing the runoff to discharge as sheet flow to a forested area where it naturally wants to do not require maintenance. This is a very rural area so there is plenty of forested area to treat the runoff.
3. The legend sheet should include a symbol for ditch turnouts. Areas where ditch turnouts are proposed are shown on the plans along with stormwater buffers but

there is no symbol on the legend to indicate that they are ditch turnouts. Ditch turnouts or cross culverts should be shown before any ditch reaches a stream.

4. The index sheet for stormwater plans, 400 and 401, state that those series are for stormwater but the sheets that follow, 402, 500 series, 600 series, 700 series and 800 series indicate they are erosion control plans. Both are closely related but the labeling should be the same to avoid confusion.

5. Standard Details –
    a. I would like to see a standard detail for a blast rock road since I believe they will be used in a number of locations. There are a number of differenced between a standard detail for blast rock roads and roads built with common borrow and gravel. Blast rock in this detail should be shown on the upslope cut face, preferably to the top of the cut but at least to the top of the area that is below the groundwater table. No soil or other material should be placed on the downslope fill extension since groundwater may need to discharge from the voids. Blast rock roads should not have ditches that extend below the bottom of the blast rock to encourage as much pass through of water as possible.
    b. Typical Ditch Turnout Detail – This detail is appropriate for ditches with cross culverts but not for typical ditch turnouts. It should be renamed something like "Ditch berm at cross culverts". The berm is used to assure ditch water will enter cross culverts and can not continue down the ditch. A ditch turnout almost always will need to be an excavation since the ditch bottom usually is lower than the ground on either side of the ditch. Therefore, two details should be shown.
    c. Typical Ditch Cross Section – I did not see any stand alone cross section detail for a typical ditch. There is one for ditches with stone protection and some of the road and crane path details show V shaped ditches that include a few specifications but I believe a stand alone detail is needed. V shaped ditches are not the recommended shape, particularly for soil based ditches. They should be trapezoidal in shape and need to be stabilized according to the expected volume, velocity and height of flowing water in them. Erosion control mulch can be used on disturbed soil surfaces above expected height of water and above any seeps but the sides and bottom of the ditch below the height of water need to be stabilized by tacked down mulch, erosion control blankets or rock, depending on how much and how fast water moves in them.
    d. Rip-rap outlet for culvert protection. The detail for a rip-rap apron at the culvert outlet is appropriate for a culvert that discharges to a concentrated flow channel. If however, a culvert is to discharge road ditch water to an area without a concentrated flow channel, the rip-rap apron should include a stone berm level spreader in a semi-circle shape at the end of the apron. This will assure the discharge of ditch water as sheet flow and prevent the scouring of a channel.
    e. Typical Level Spreader – The standard details sheet indicates that "all level spreaders shall be constructed in cut sections". That may be

appropriate for ditch turnouts but I believe that stone level spreaders can be constructed for some areas without the need for an excavation or cut. Just place stone in a semi-circle shape on the undisturbed ground surface. Water will filter through the stone voids so that sheet flow is assured, even if the ground surface is a little irregular. I would like to see a detail for that type of application as well as the one with a cut.

f. Stone Check Dam Detail – This detail should include a size range for the stone to be used for the check dams (2"-3"). Blast rock is not appropriate for use in check dams as it usually has voids that are too large to be effective. This detail notes that "spacing of dams may be adjusted within rip-rap/blast rock armored ditches as approved by engineer". Why would stone check dams be needed for rip-rap or blast rock armored ditches?

g. Stoned Bermed Level Lip Spreader Detail – This detail should include a stone size for the level spreader (2"-3").

h. Typical Stone Ditch Protection Detail – This detail indicates that rip-rap will be used to line all ditches exceeding 5% slope, which is appropriate. It is also appropriate to line ditches with rip-rap on lesser slopes if those ditches are to be constructed below the groundwater table, particularly if the length of slope is significant. This will typically occur when road cuts are made perpendicular to the slope. These ditches must carry water until they can outlet, which may be a considerable distance. They will be hard to vegetate due to prolonged wetness. The rip-rap protection should go up the cut face at least to the height of the seasonal ground water table to allow seeps to enter the ditch through voids in the stone. No filter fabric should be used above the expected height of the flowing water in the ditch. There will not be any threat of scouring from flowing water in this area. The issue here is to allow the seeping water to enter the ditch through the voids in the stone while preventing the soils themselves from slumping into the ditch. A bedding layer of gravel or small stone can be used for the rip-rap stone.

i. Organic/Duff Waste Disposal Detail – This detail indicates that all organic waste/duff will be disposed of along the downslope side of road fill extensions. That may be ok in some locations but may be a problem in others such as where a rock sandwich or blast rock is used and where significant amounts of runoff water will flow over the side of the road. I suggest the material simply be spread over the ground surface where it will decompose slowly. It can also be mixed with soil to form topsoil or it can be spread as is over blast rock surfaces on flat or gentle slopes to soften the appearance and/or narrow the road surface and provide a seed bed for native vegetation to become established.

j. Typical Rock Sandwich Detail – This detail should be revised as follows: No filter fabric should be used under the rock on the upslope side of the road, above the expected height of flowing water. It is not needed because there will be no pressure forcing the stone into the underlying soil or scouring by flowing water. Instead, a layer of coarse gravel that is permeable enough to allow the seeping water into the rock layer should be used. Filter fabric may not be permeable enough to accommodate the seeping water so it will be circumvented and become problematic. A note is included with this detail indicating that culverts may be used with rock sandwiches and indicates that they are to be installed at a higher elevation than the bottom of the rock sandwich which is appropriate. It would be helpful, however, to depict a culvert in the standard detail to show contractors how they should be installed. Another note indicates that the rock on the downslope side of the detail should be "Tied into the existing subsurface drainage layer". This note should be removed since the rock on the downslope side should be placed on the existing soil surface. If it was to be tied into the existing subsurface layer, it would be unable to discharge properly and would back-up.

k. Superelevated Road Detail – The typical road details show road surfaces with a crown. This is appropriate for most roads but sometimes it is desirable to have the entire road surface slope to one side, for phosphorous control or for drainage purposes. Such roads are called a "superelevated" road. I would like to see a standard detail for a superelevated road so that the contractor has that technique to use at his/her discretion, along with the project engineer and third party inspector.

l. Typical Uphill Cut Road Detail – This detail includes a note saying that "ditches shall be constructed to not intercept the groundwater table". For some projects that is possible and a desirable goal. For windfarm projects, which typically include steep slopes, deep cuts and the need for roads with slopes of less than 12%, that restriction is not practical. I suggest removing that note and replacing it with another one that indicates; ditches constructed below the seasonal groundwater table, with a significant upslope watershed, will be rock lined (for cuts on both sides) or will use rock sandwiches (for cuts on one side and a fill on the other).

m. Rock Burrito – The applicant may want to add a standard detail for a rock burrito which can be used in place of a cross culvert in locations where expected flows are not significant and include groundwater. Rock burrito's are trenches filled with 3" – 6" rock that is fabric wrapped but open at each end (mini rock sandwiches). They do not heave, rust or collapse. When used to transmit groundwater, they do not freeze due to the latent heat of the groundwater.

6. There are a number of landing yard/laydown areas depicted on the plans but there are no details about how those sites are to be prepared. If only trees are to be cut but no stumps removed or ground leveled, I see no issues (provided that heavy equipment stays off the site when the soil is saturated). If however, stumps are to be removed and the ground is to be leveled, there should be soil erosion/sediment control measures shown as well as stormwater measures. For stormwater, since these are fairly large areas, the land should be shaped to direct runoff to as many directions as possible. This will limit the length of slope over which runoff can travel, limiting its ability to cause erosion and sedimentation. Ideally, finished contours as well as erosion/sediment control measures and stormwater management measures should be shown on the construction plans for a contractor

to follow for all sites. At a minimum, for most of the sites, a narrative description of what construction activities will be required and erosion/sediment control and stormwater management measures will be used should be included. A few of the sites are proposed to be located on wet soils. Those should have site specific design details provided.

7. Baskahegan Access Road Plan and Profile – The Baskahegan Access Road plan, station 0+00 to station 34+00, does not include any soils mapping information (pages 20 and 21). I would like to see the soil mapping information for this road.
8. Some fill extensions depicted on the plans appear to be excessive, up to 250 feet in length. In talking with the project engineer, I understand that is being done to show a worse case scenario. I recommend, as stated above, the plans be revised to show blast rock roads in steeply sloping areas to reduce the fill extension foot print.
9. Rock Sandwich Locations on Plans – As mentioned in the general comments section, I believe that more than 1 or possibly 2 rock sandwiches will likely be needed for this project. Examples of areas where rock sandwiches (and/or blast rock roads) may be needed include (but are not limited to): South Peak Access Road sta. 2000+00 – 2056+00, Dill Hill Road sta. 52+00 to 62+00, 68+00 to 73+00, Dill Hill Crane Road sta. 114+00 to 119+75, 188+00 to 196+00. These are areas with somewhat poorly drained or wetter soils that appear to have roads constructed at grade or with a slight cut. I suggest these and similar areas be highlighted on the plans and include a note that says "install rock sandwich or equivalent if road base and/or ditch bottom is below the seasonal groundwater table" or something similar. Doing so will minimize the alteration of the natural hydrology and make a stronger road that is usable year round. Blast rock road base and rock burritos can also be used in these areas, in conjunction with rock sandwiches.
10. Turbine Pads and Crane Paths – The standard details for constructing turbine pads and crane paths appear to require that they be constructed on the existing soil or of compacted fill with a gravel surface. If turbine pads are to be built with cuts and fills, there are likely to be compaction issues, hydrology (groundwater) issues, fill extension issues and stormwater runoff issues. If blast rock were to be used, none of the issues just listed will be a concern. Crane paths built along ridge tops with steep side slopes will require long fill extensions if built of soil material instead of blast rock (up to 250 feet according to the plans). Therefore, I recommend that turbine pads and crane paths to be constructed on steep slopes, be constructed with blast rock fill. Another standard detail should be added to show turbine pads and crane paths built on a base of blast rock. There should be plenty of blast rock for this purpose based on the proposed amounts of cuts along the crane paths which are mostly shallow to bedrock soils. Erosion control mulch can be placed on the blast rock surface to soften the appearance after construction and to allow for some natural re-vegetation, if desired.
11. Ridge Line Crane Paths – The proposed crane path along the ridge line crosses through a few areas of somewhat poorly drained soils, as mentioned above. None of the roads shown crossing these areas indicate that rock sandwiches will be used. If these ridge top roads are to be built with blast rock, as I believe they

should, there is less of a need for rock sandwiches since blast rock is porous. If however, these roads are to be built out of common borrow and gravel, rock sandwiches will be needed.

12. Dill Hill Crane Path Laydown Area Sta. 115+50 to 121+25 – The majority of this proposed laydown area will be on soils with a shallow seasonal groundwater table. The soil pit logged for this map unit has a seasonal groundwater table at 11 inches below the organic horizon. Another soil pit for this map unit has an even shallower ground water table. It would be my recommendation that this laydown area be leveled by adding fill material instead of cuts and fills as is commonly the practice, unless the cuts are from knolls with a much greater depth to seasonal groundwater table. Cuts elsewhere will likely intercept the groundwater table and pose a problem. There should be plenty of material nearby to use for the fill material that can be taken from road and/or turbine pad cuts.
13. O&M Building laydown Area – The area proposed to be used for laydown that is adjacent to the O&M building includes a Telos soil map unit. I do not know the depth to the seasonal groundwater table for this map unit because I do not have the test pit logs for soil pits excavated within it (the application should be amended to include these test pit logs). As I understand from a conversation with the project engineer, this was an expanded area of investigation and somehow the soil pit logs did not make it into the application. Typically, the depth to seasonal groundwater table for the Telos series is 8”-12” below the organic duff layer. Judging from adjacent soil map units and contours in the area, I suspect that this Telos map unit is the hydrology path that connects upgradient areas with a wetland east of the transmission line (subsurface and surface in the spring and fall and after heavy rainfall). Therefore, any leveling and filling of the Telos map unit should be done is such a way so as to not interrupt the hydrological connection. That can be done by the use of culverts, blast rock and/or a rock sandwich.
14. O&M Building Septic System – The application includes a septic system design that is no longer relevant. According to the project engineer, a new location was chosen but the application failed to include the new design and location. That should be corrected.
15. Transmission Line and Substation Soil Mapping – I have a few questions about the transmission line and substation soil mapping. Included are; (a) soil profile descriptions, (b) soil series determinations, and (c) hydraulically sensitive area delineations on the transmission line soil map.
    a. A number of the soil profile descriptions do not represent typical unaltered soil profiles. Included are soil horizons that appear to be out of place or are not in the usual order. Do they represent filled or disturbed soils? If so, do they represent the average soil condition within the soil map units? If that is the case, they should be called a Udorthent. If not, a more representative soil profile should be used to support the map unit classification.
    b. A number of soil series classifications do not look like they match the soil profile descriptions upon which they are based. Is that because they represent an inclusion and not the average condition within the map unit?

c. The transmission line soil map includes cross hatching for hydraulically sensitive areas. Generally, these areas were mapped as complexes of poorly drained and somewhat poorly drained soils, which is appropriate. Not all somewhat poorly and poorly drained soil map units however were cross hatched. That may have been because some met the standard soil taxonomy definition of poorly and somewhat poorly drained soils. This section of the application includes a discussion of "hydraulically sensitive areas" which is limited to those areas that do not meet the standard definition in taxonomy. Since my overall interest is in providing information for the contractor, to know which soil map units have a seasonal groundwater table near the surface in the spring and fall as well as after significant rainfall events, the map units which include poorly and somewhat poorly drained soils meeting the definition in taxonomy should also be cross hatched. They may not meet the application's definition of "hydraulically sensitive areas" but they will pose the same construction problems to the contractor.

I suggest these issues be clarified, before any construction begins on the transmission line. It is important for these issues to be resolved prior to beginning construction so that the contractor knows where problem areas are, how many there are, how extensive they are, and what measures he/she will need to use to work in them. Knowing this upfront will help with the planning process.

16. Transmission Line Construction Details – I did not find any narrative discussion, in my copy of the application for this project, about proposed construction techniques to be used in constructing the transmission line. There were though, construction details for the substation and substation access road which I comment on in 18 and 19 below. It may just be that my copy of the application does not include that information. If so, I would be happy to review those construction details. If not, I suggest the incorporation of construction details for stream and wetland crossings. Typically, timber mats are used to cross wetlands by heavy equipment. I also suggest the transmission line plan show areas that are somewhat poorly drained or wetter, including the hydraulically sensitive areas. These areas have soils with a seasonal ground water table very near the soil surface in the spring, fall and after rainfall events. They are quite subject to rutting and subsequent alteration of the natural hydrology and therefore need to be crossed using construction techniques that take this into consideration. The plans should indicate that these areas will be crossed in one of three ways: (1) during the driest summer months of July, August or September when the soil is not saturated. Because Maine can sometimes have rainy summer months, dry soil conditions should be verified before crossing these areas. Conversely, it may be possible to work on them in another month if precipitation levels are below normal, (2) during the winter months when the soil is frozen and snow covered. This may require compacting the snow cover to make sure the soil below is sufficiently frozen to support the weight of construction vehicles, or (3) by the use of timber mats similar to crossing wetlands when the soils are saturated and not frozen. With proper planning, the contractor can schedule work on the better

drained soils in the wetter time of year, leaving the drier time of year and frozen ground conditions for the wetter soils. It is important however, for the contractor to avoid construction on any soils when they are saturated, including the better drained soils. The better drained soils drain faster after precipitation so they can be worked on sooner than the wetter soils.

17. Transmission Line Access – I did not find any discussion of how equipment will be accessing the transmission line but did note a few existing roads, logging roads and skid trails do intersect it. I assume that these existing accessways will be the primary means of reaching the transmission line with equipment. If the applicant should however, need to access the transmission line in another location where there is no existing road or skid trail, that should be accomplished using the techniques discussed above (16) for work on the transmission line.
18. Substation Site Soil Conditions – The substation soil map indicates that the substation site soils are a Dixmont/Monarda complex. The single soil pit shown on the map for this map unit indicates that there was standing water in the pit on the day it was excavated at a depth of 2 inches (though the soil profile description does not look like a poorly drained soil). A Dixmont/Monarda complex is a wet soil map unit and therefore should include construction techniques to overcome the shallow depth to seasonal ground water table, particularly since the applicant is proposing a deep cut on the upslope side. Those construction techniques should be part of the application. I recommend using rock burrito's as one of the construction techniques. I made a similar recommendation for the substation at Kibby and it has worked very well. The rock burritos should be installed below the base of the substation and then outlet through rip-rap facing on the downslope fill extension. There should still be a rock lined ditch around the site but it would be constructed a few inches above the invert elevation of the rock burritos, to act more as an overflow mechanism. By using the rock burritos, there would be significantly less alteration of the natural hydrology. Another recommendation is to outlet the proposed perimeter ditch through stone bermed level spreaders, on either side of the substation.
19. Substation and Substation Access Road Standard Details – I recommend the following revisions to the standard details sheets for this part of the project:
    a. Add a standard detail for a rock sandwich consistent with the (revised) one on the James W. Sewall plans for the rest of the project. There are a couple of wetland crossings that should utilize that type of road building technique.
    b. The applicant might also want to include a standard detail for a blast rock road since a considerable amount of fill is proposed to be used in some locations. That would decrease the length of the proposed fill extension.
    c. Ditch Turnout Detail – There should be a standard detail for a ditch turnout. Turnouts should be installed prior to ditches in the cut sections approaching deep fills associated with wetland crossings. These turnouts should assure the ditch water discharges as sheet flow to prevent sediment discharge into the wetlands.
    d. Culvert Inlet and Outlet Protection Detail – There should be a detail showing armored inlets and outlets of the proposed culverts.

e. Typical Ditch Detail – There should be a detail of a typical road ditch showing a trapezoidal shape as well as how to stabilize them.
f. There should be provisions for stockpiling (or disposing of) topsoil and organic duff removed from the roadbed and substation site.
g. Rock Burrito – I recommend a standard detail for a rock burrito, which I suggest using for the substation site. A rock burrito is simply a trench that is filled with 3” – 6” stone and then wrapped in fabric. Each end of the rock burrito is open to allow for the free passage of water, similar to a culvert. They are more durable than a culvert which is a benefit when replacing a culvert would be very difficult and they do not heave or crush.