

**TRANSMISSION LINE LEASE****BETWEEN****DEPARTMENT OF AGRICULTURE, CONSERVATION AND  
FORESTRY  
BUREAU OF PARKS AND LANDS  
and CENTRAL MAINE POWER COMPANY**

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This Lease Agreement is made by and between the State of Maine, by the Bureau of Parks and Lands, Department of Agriculture, Conservation and Forestry (hereinafter called the "Lessor"), acting pursuant to the provisions of Title 12 M.R.S.A. §1852(4), and Central Maine Power Company, a Maine corporation with its principal place of business at 83 Edison Drive, Augusta, Maine (hereinafter called "Lessee"). For the considerations hereinafter set forth, the Lessor hereby leases to Lessee, and Lessee hereby takes from the Lessor, the non-exclusive use of that portion of the West Forks Plantation and Johnson Mountain Township (T2 R6 BKP WKR) Maine Public Reserved Lands in Somerset County, Maine described in Exhibit "A" and shown on Exhibit "B" attached hereto and incorporated herein, being a three hundred (300) foot wide by approximately one mile long transmission line corridor located on a portion of the aforementioned Maine Public Reserved Lands. The described transmission line corridor, together with the improvements now or hereafter to be placed thereon, is hereinafter referred to as the "Property" or "Premises," and is subject to the following terms and conditions:

1. Term:

- a. This lease shall be in effect from the date of execution of this instrument for a term of twenty-five (25) years and, at no less than 5 year intervals, the term of this lease may be extended by mutual agreement for additional years as will grant Lessee a remaining lease term totaling no more than twenty-five (25) years, so long as Lessee is in compliance with the conditions of this lease. Lessee shall not request a lease term extension any more often than once every five years. Notice of any lease extension shall be given to Lessor at least six (6) months prior to the expiration of any initial term or renewal period.
- b. Lessor reserves the right to terminate this Lease at any time during the term hereof to the extent permitted under the provisions contained in paragraph 13 Default.
- c. Lessee has the right to terminate this Lease upon at least ninety (90) days prior written notice to Lessor, or such lesser notice period as agreed to by Lessor in writing.
- d. Any notice required by this paragraph, whether by Lessee or Lessor, shall be sent postage pre-paid, registered or certified mail, return receipt requested, to the party at the address set forth in paragraph 24.

2. Rent. Lessee shall pay to the Lessor rental as follows:

An annual payment of \$1,400.00. The first payment shall be due on the date of execution of this lease (the "Initial Payment") and subsequent annual payments shall be made on or before December first of each following year. Lessor or Lessee may, within the first twelve months of the lease and at either Lessor's or Lessee's sole discretion, commission an appraisal of the Premises. Both Lessor and Lessee shall agree on the Appraiser to be assigned the appraisal assignment. Lessee agrees to pay any additional value above the Initial Payment indicated by the appraisal and the cost of the appraisal. The annual payment shall be adjusted each year in an amount not to exceed the average increase in the Consumer Price Index as published by the Bureau of Labor Statistics, United States Department of Labor over the preceding one year period.

In addition, Lessee shall pay to Lessor the negotiated price of the timber present on the Premises based on mill scale and stumpage value at time the corridor is harvested for the construction of the utility corridor.

3. Use. The Property shall be used by the Lessee as follows: to erect, construct, reconstruct, replace, remove, maintain, operate, repair, upgrade, and use poles, towers, wires, switches, and other above-ground structures and apparatus used or useful for the above-ground transmission of electricity ("Facilities"), all as the Lessee, its successors and assigns, may from time to time require upon, along, and across said Property; to enter upon the Property at any time with personnel and conveyances and all necessary tools and machinery to maintain the Premises and facilities; the non-exclusive right of ingress to and egress from the Premises over and across the land of the Lessor; to transmit electricity and communication, as conditioned below, over said wires, cables, or apparatus installed on Lessee's facilities. Lessee shall own all communication facilities and such facilities shall be for Lessee's use in its business as a public utility. In the event Lessee desires to provide capacity to others on Lessee's communication facilities, Lessee shall first obtain Lessor's written approval, which shall not be unreasonably withheld. Lessor may adjust the rent at such time as Lessee provides communication capacity to others. The rent adjustment is to be determined by an appraisal paid for by Lessee. Both Lessor and Lessee shall agree on the Appraiser to be assigned the appraisal assignment. Lessee shall not sub-lease or contract the communication facilities for any other commercial use. The Lessor further grants to said Lessee the right to establish any and all safety and reliability regulations applicable to said transmission line corridor which said Lessee deems necessary and proper for the safe and reliable construction and maintenance of said structures, wires, and apparatus and for the transmission of electricity.
4. Quiet Enjoyment. So long as Lessee pays the rent, performs all of its non-monetary obligations, and otherwise complies with the provisions of this Lease, the Lessee's possession of the Premises for its intended use will not be disturbed by the Lessor, its successors and assigns except as otherwise provided under the terms of this Lease. Notwithstanding any provision to the contrary herein, Lessor reserves the right to enter onto the Premises at any time and from time to time to inspect the Premises.

5. Access:

- a. It is agreed by the parties to this Lease that Lessor is under no obligation to construct or maintain access to the Premises, notwithstanding any provisions of any federal, state and local law to the contrary. However, the Lessee shall be allowed to cross Lessor's abutting land by using Lessor's Forest Management Roads for access to the Premises for construction, maintenance and repairs, subject to reasonable restrictions and regulations imposed by Lessor, and the rights of others using said roads. Upon reasonable advance notice to Lessee, Lessor reserves the right to close, lock or otherwise restrict access along or through the Forest Management Roads at any time it appears reasonably necessary to protect the safety of persons or property. Such situations include, but are not limited to, spring mud season or periods of high fire danger. Lessee shall immediately repair any damage to the road caused by Lessee. Lessor is under no obligation to provide maintenance to the road. If Lessee wishes to undertake performing repairs or upgrades to the Forest Management Roads, Lessee must acquire prior written approval from Lessor. Lessee shall acquire prior written approval for the construction or use of any other access location across Lessor's land abutting the Premises which approval shall not be unreasonably withheld, delayed, or conditioned.
- b. The Lessor expressly reserves the right for itself or its guests, servants, or agents to pass and repass over the described Premises at any and all times with machinery and equipment necessary for the operation or conduct of Lessor's uses as such uses may from time to time exist, provided that: said uses will comply with the above referenced safety regulations and any applicable state law, and will not prohibit the Lessee from complying with the conditions or requirements imposed by permitting agencies; that the Lessor shall provide Lessee with at least three business days prior written notice if Lessor will be on the Premises with construction or logging equipment; and that such use will not unreasonably interfere with the rights of Lessee herein conveyed.

6. Lessee Covenants. The Lessee covenants as follows:

- a. No buildings, either permanent or temporary, may be constructed or placed upon the described Premises, except temporary structures during construction of the Facilities, such as field trailers.
- b. Crossing mats for stream or wetland crossings shall not be made of ash or hemlock, so as to avoid introduction of invasive pests associated with these species.
- c. No hazardous or toxic waste substance or material, residual pesticides or fertilizers, other than organic compost, shall be used or kept upon the Premises or any portion thereof, nor shall any livestock or poultry be kept temporarily or permanently thereon. Pesticides, herbicides, and chemical defoliants registered for use in Maine may be applied to the Premises only after acquiring prior written approval from Lessor and only by trained applicators working under the supervision of applicators

licensed by the State of Maine in formulations and dosages approved by the Environmental Protection Agency and Lessor. One month prior to all pesticide applications, Lessee shall provide information to Lessor, including, but not limited to pesticides, herbicides, and chemical defoliant to be used, dates and methods of application, application locations and reasons for use.

- d. There shall be no vegetation removal that would result in less than 50% aerial coverage of woody vegetation and stream shading within 25 feet of a stream.
- e. There shall be no vegetation maintenance or disturbance within a 50-foot radius around the high water boundary of a significant vernal pool from March 15 – July 15; provided, however, that Lessee may take all appropriate actions with regards to vegetation management to ensure that Lessee is in compliance with all federal and state laws, rules and regulations imposed upon Lessee as the owner and operator of the Facilities.
- f. Lessee shall not make any strip or waste of the Leased Premises or of any other lands of Lessor. Vegetation clearing within the Leased Premises for Lessee's Facilities shall be limited to standards approved by the Maine Public Utilities Commission and shall encourage a ground cover of woody species with a maximum mature height approaching but not exceeding 15 feet. Lessee shall make every effort to minimize clearings and cutting of vegetation.
- g. Lessee acknowledges that lease of the Premises by the Bureau of Parks and Lands, Department of Agriculture, Conservation and Forestry is unique, and that in authorizing the Lease under 12 M.R.S. § 1852(4)(A), Lessor requires that Lessee shall make every reasonable effort within the leased Premises to be in conformance with the Maine Department of Inland Fisheries and Wildlife "Recommended Performance Standards for Inland Waterfowl and Wadingbird Habitats in Overhead Utility ROW Projects", "Recommended Performance Standards for Maine's Significant Vernal Pools in Overhead Utility ROW Projects", and "Recommended Performance Standards for Riparian Buffers in Overhead Utility ROW Projects", all dated March 26, 2012, which copies are attached to this lease, or the publication's most current version.
- h. Lessee shall not kindle any outside fires on the Premises or any other land of the Lessor, except in accordance with applicable federal, state and local regulations, and hereby agrees to assist with any means at Lessee's disposal in putting out fires occurring on the Premises or adjacent areas, and to report promptly such fires to Lessor or its representative and to the appropriate authorities.
- i. Lessee agrees to maintain the Premises in a neat and sanitary manner and to provide for proper disposal of all garbage, trash, septic (for purposes of this Lease, "septic" shall mean, but is not limited to, sewage, wash water, black water, gray water and slop water), and other waste in compliance with all applicable federal, state and local laws and in a manner so as not to be objectionable or detract from the aesthetic values of the general area. Lessee shall not discharge any untreated or partially treated sewage or other waste materials directly or indirectly into any body of water including but not limited to, any wetland, stream, river, lake, pond, or

groundwater. In addition, Lessee covenants that it bears the responsibility for any noncompliance with all federal, state and local laws and regulations governing septic and other waste disposal resulting from Lessee's activities and Lessee shall indemnify and hold harmless Lessor from and against any and all actions, suits, damages and claims by any party by reason of noncompliance by Lessee with such laws and regulations. Such indemnification shall include all Lessor's costs, including, but not limited to reasonable attorney fees.

- j. No non-forest waste including, but not limited to, broken equipment, spilt fuels, fluids and lubricants, fluid and lubricant containers, equipment parts, tires, debris, garbage, or trash shall be deposited, discharged, dumped or buried upon the Premises. Forest woody waste (e.g., wood chips and stumps) may be disposed of on the premises, but may not be disposed of in piles. Stumps shall be buried in "stump dump" holes, except that small numbers of stumps (four or less) may be left aboveground. All non-forest waste shall be disposed of legally and not on property of Lessor.
- k. Lessee shall not build permanent roads on the Premises without obtaining prior specific written permission from the Lessor; provided, however, that Lessee may construct a minimal number of temporary roads and trails to facilitate the construction of the transmission line (tree clearing, pole setting, wiring). At the time construction is completed, all temporary roads and trails shall be dismantled and put to bed or converted to permanent access trails. All access trails shall be built to Best Management Practices (BMP) standards as shown in the "Maine Motorized Trail Construction and Maintenance Manual" written by the Bureau of Parks and Lands Off-Road Vehicle Division, dated May 2011 and all roads shall be built pursuant to those Best Management Practices (BMPs) standards pertaining to forest management and road construction practices set forth in the publication entitled, "Best Management Practices for Forestry: Protecting Maine's Water Quality," prepared by the Maine Department of Agriculture, Conservation and Forestry, Maine Forest Service, in such publication's most current version at the time of the grant of this lease, and as the same may be further amended, supplemented or replaced after the date of the execution of this lease.

Prior to start of construction, Lessee shall provide an Access and Maintenance Plan to Lessor for review and approval. This plan shall provide details and maps on proposed roads, permanent and temporary, access points, temporary trails, inspection, and maintenance access, and descriptions of any proposed bridges, temporary or permanent.
- l. Natural Plant Community, wetland and Significant Vernal Pool field surveys of the Premises must be conducted by Lessee or Lessee's designee prior to any construction on the Premises. Lessee shall send to Lessor and to the Maine Department of Inland Fisheries and Wildlife a copy of all completed surveys before commencing any construction on the Premises.
- m. Lessee shall be in compliance with all Federal, State and local statutes, ordinances, rules, and regulations, now or hereinafter enacted which may be applicable to Lessee in connection to its use of the Premises. Lessee further shall

not construct, alter or operate the described Premises in any way until all necessary permits and licenses have been obtained for such construction, alteration or operation. Lessee shall provide written confirmation that Lessee has obtained all material permits and licenses to construct and operate the Facilities. Lessee shall furnish Lessor with copies of all such permits and licenses, together with renewals thereof to Lessor upon the written request of Lessor. This lease shall terminate at the discretion of the Lessor for failure of Lessee to obtain all such required permits. Prior to such termination, however, Lessor shall provide written notice to Lessee of such failure and Lessee shall have 30 days in which to cure such failure.

n. In the event of the following:

- a) Lessee constructs an electric transmission line on the Premises; and
- b) Lessee has determined, in its sole discretion, to rebuild the existing transmission line (the "Jackman Tie Line") located on that part of the existing 100-foot wide utility corridor described in a lease dated July 9, 1963 and recorded in the Somerset County Registry of Deeds, Book 679, Page 37 (the "Jackman Tie Line Lease") that is located westerly of the Premises and easterly of Route 201; and
- c) Lessee receives all permits and regulatory approvals necessary to rebuild the line in such new location including, but not limited to, approvals of the Maine Public Utilities Commission and the Maine Department of Environmental Protection; then

Lessee agrees to relocate said Jackman Tie Line from the above described portion of the Jackman Tie Line Lease to a location on the Premises and such other corridor as acquired by the Lessee from others. Upon completion of any such relocation of the Jackman Tie Line or its functional replacement pursuant to this section and removal of Lessee's facilities from that portion of the Jackman Tie Line Lease lying westerly of the Premises, Lessor and Lessee agree to amend the Jackman Tie Line Lease to delete from the lease area that portion of the Jackman Tie Line Lease lying westerly of the Premises. All other terms and conditions of the Jackman Tie Line Lease shall remain in full force and effect. The term "rebuild" as used in this paragraph, shall not include routine repair or replacement of poles, crossarms, insulators, braces or conductor.

7. Liability and Insurance.

a. Lessee shall without unreasonable delay inform Lessor of all risks, hazards and dangerous conditions caused by Lessee which are outside of the normal scope of constructing and operating the Facilities of which Lessee becomes aware of with regards to the Premises. Lessee assumes full control of the Premises, except as is reserved by Lessor herein, and is responsible for all risks, hazards and conditions on the Premises caused by Lessee.

b. Except for the conduct of Lessor and Lessor's guests and agents, Lessor shall not be liable to Lessee for any injury or harm to any person, including Lessee, occurring in or on the Premises or for any injury or damage to the Premises, to any property of the Lessee, or to any property of any third person or entity. Lessee shall indemnify and defend and hold and save Lessor harmless, including, but not limited

to costs and attorney fees, from: (a) any and all suits, claims and demands of any kind or nature, by and on behalf of any person or entity, arising out of or based upon any incident, occurrence, injury, or damage which shall or may happen in or on the Premises that is caused by the Lessee or its Agents; and (b) any matter or thing arising out of the condition, maintenance, repair, alteration, use, occupation or operation of the Premises, the installation of any property thereon or the removal of any property therefrom that is done by the Lessee or its Agents. Lessee shall further indemnify Lessor against all actions, suits, damages, and claims by whoever brought or made by reason of the nonobservance or nonperformance of Lessee or its Agents of: (a) any obligation under this Lease; or (b) any federal, state, local law or regulation pertaining to Lessee's use of the Premises.

c. The Lessee shall obtain and keep in force, for the duration of this lease, a liability policy issued by a company fully licensed or designated as an eligible surplus line insurer to do business in this State by the Maine Department of Professional & Financial Regulation, Bureau of Insurance, which policy includes the activity to be covered by this Lease with adequate liability coverage over at least one million dollars for each occurrence and two million dollars in annual aggregate in general commercial liability coverage to protect the Lessee and the Lessor from suits for bodily injury and damage to property. Nothing in this provision, however, is intended to waive the immunity of the Lessor. Upon execution of this Lease, the Lessee shall furnish the Lessor with a certificate of insurance as verification of the existence of such liability insurance policy.

8. Lessee's Liability for Damages. Lessee shall be responsible to Lessor for any damages caused directly or indirectly by Lessee or its guests, servants or agents, including, but not limited to, interference or meddling with any tools, machinery, equipment, gates, buildings, furniture, provisions or other property of the Lessor on the Premises, its agents, employees or guests.
9. Tax Proration. Lessee shall pay when due all taxes levied on the personal property and improvements constructed by Lessee and located on the Premises. Lessor shall be responsible for any real property taxes levied on the Premises based on unimproved land. Lessor shall have no ownership or other interest in any of the Facilities on the Property and Lessee may remove any or all of the Facilities at any time.
10. Lease Assignment, Sublease and Colocation: Lessee shall not assign or sublease in whole or part without prior written consent of Lessor, which consent shall not be unreasonably withheld. Lessor may lease the Premises for other compatible uses and colocation of other utilities so long as such rights do not extend to access to the Facilities, said uses will not prohibit the Lessee from complying with the conditions or requirements imposed by permitting agencies, and such use will not interfere with the rights herein conveyed, including the right to build such additional Facilities as may be accommodated on the Premises using transmission line spacing standards approved by the Maine Public Utilities Commission.
11. Lessee's Removal of Structures: Lessee must obtain Lessor's advance written consent, which consent shall not be unreasonably withheld, delayed, or conditioned, to the method of removal before any structures or improvements are removed from the Premises.

12. **Surrender.** Upon termination of this Lease for any reason, Lessee shall deliver the Premises to Lessor peaceably, without demand, and in reasonably good condition clear of all trash and debris, unusable equipment, unregistered vehicles and abandoned equipment and structures, located on the Premises by Lessee or its Agents. If such trash and debris and other unusable equipment, unregistered vehicles, and abandoned equipment and structures are not removed within one hundred eighty days (180) days of the termination of this Lease, the Lessor shall thereafter have the right to remove it and Lessee shall reimburse Lessor for the costs of such removal and disposal. Any other personal property, fixture, or structure on the Premises belonging to Lessee shall be removed by Lessee, unless Lessor requests in writing, that the other personal property, fixture, or structure may remain and Lessee agrees in writing not to remove it. If the Lessee fails to remove such other personal property, fixture, or structure such items shall be deemed the property of the Lessor two hundred and ten days (210) days after termination of the Lease and the Lessor shall thereafter have the right to remove it and charge the Lessee with the costs of such removal and disposal. In the event that any of this other personal property, fixtures, or structures on the Premises are incapable of being removed within one hundred eighty days (180) days, Lessee may be allotted up to one year to remove the items, with prior written approval from Lessor, which approval shall not be unreasonably, delayed, or conditioned. Any holding over by Lessee without Lessor's prior written consent shall be considered a tenancy at sufferance.

13. **Default.**

a. The following constitutes a default under this Lease: (1) Lessee's failure to perform any of its monetary or nonmonetary obligations under this Lease; (2) the filing of any bankruptcy or insolvency petition by or against Lessee or if Lessee makes a general assignment for the benefit of creditors which is not resolved or withdrawn within 30 days of such petition being filed; (3) an execution, lien, or attachment issued against the Lease, the Premises, or Lessee's property on the Premises, unless Lessee provides Lessor with satisfactory assurances and evidence that such execution, lien, or attachment will be released within a reasonable time not to exceed ninety (90) days, unless a shorter period of time is provided for by any applicable law or proceeding for the removal thereof, in which case the more restrictive time limitation applies; (4) the assignment or sublease of this lease to any third party without Lessor's prior written consent; or (5) the violation of any state, federal or local law, rule, regulation, or ordinance; or (6) Lessee's abandonment of the leased premises.

b. Upon the occurrence of any such event of default and subject to any applicable cure period as defined in paragraph 6(m), above, Lessor may, in addition to (and not instead of) any other remedies available at law or in equity, terminate this lease with notice or demand to Lessee and enter and take possession of the leased premises. Lessee shall be liable to Lessor for loss and expense, including reasonable attorney fees, incurred by reason of such default or termination hereof Lessor will provide Lessee with written notice of an event or occurrence of default under paragraph 13(a)(1) and Lessee shall have a reasonable period of time, as determined by Lessor, to cure said default which period shall not exceed thirty (30) days; provided, however, that if Lessee satisfies to Lessor that Lessee has



undertaken the appropriate actions to cure said default and such default has not been cured within the said time permitted, the Lessor may exercise its sole discretion to extend the cure period.

14. Statutory Authority Over Public Lands. Lessor shall have the right to request that this Lease be amended from time to time and throughout the term of this lease in the event that any Lease term is found not to comply with Maine state law regarding the lease of property under 12 M.R.S. § 1852(4). Lessor shall send notice to Lessee of the proposed revision. Upon receipt of such notice, Lessee shall have the option to either terminate the Lease by notifying Lessor in writing within thirty (30) days of receipt of notice or negotiate an amendment to the Lease in order to bring such term in compliance with said state law. Except as provided in this Lease, neither Party shall have the right to terminate this lease unless the resulting non-compliance constitutes a default under Section 13 hereof, in which case Section 13 shall govern.
15. Mechanics Lien. If any notice is filed at the county registry of deeds of a builder's, supplier's or mechanic's lien on the Premises, arising out of any work performed by or on behalf of Lessee, Lessee shall cause such lien to be discharged or released immediately and shall indemnify Lessor against any such claim or lien, including all costs and attorney fees that Lessor may incur in connection with the same.
16. Succession; No Partnership. This Lease shall be binding upon and inure to the benefit of the heirs, executors, administrators, successors in interest and assigns of the parties hereto. Nothing in this agreement shall be construed to create an association, joint venture, trust or partnership covenant, obligation, or liability on or with regards to any of the parties to this agreement.
17. Waiver. Any consent, express or implied, by Lessor to any breach by Lessee of any covenant or condition of this Lease shall not constitute a waiver by the Lessor of any prior or succeeding breach by Lessee of the same or any other covenant or condition of this Lease. Acceptance by Lessor of rent or other payment with knowledge of a breach or default by Lessee under any term on this Lease shall not constitute a waiver by Lessor of such breach or default.
18. Force Majeure. Except as expressly provided herein, there shall be no abatement, diminution, or reduction of the rent or other charges payable by Lessee hereunder, based upon any act of God, any act of the enemy, governmental action, or other casualty, cause or happening beyond the control of the parties hereto.
19. Eminent Domain. In the event that the Premises or any portion thereof shall be lawfully condemned or taken by any public authority, Lessor may, in its discretion, elect either: (a) to terminate the Lease; or (b) to allow this Lease to continue in effect in accordance with its terms, provided, however, that a portion of the rent shall abate equal to the proportion of the Premises so condemned or taken. All condemnation proceeds shall be Lessor's sole property without any offset for Lessee's interests hereunder.
20. Holding Over. If Lessee holds over after the termination of this Lease, said hold over shall be deemed to be a trespass.

21. **Lessor Protection.** Lessor expressly retains and nothing contained herein shall be construed as a release or limitation by Lessor of any and all applicable liability protections under Maine law. Lessor specifically retains any and all protections provided under Maine law to owners of land, including but not limited to those provided under the Maine Tort Claims Act, 14 M.R.S.A. §§ 8101-8118.
22. **Cumulative Remedies.** The remedies provided Lessor by this Lease are not exclusive of other remedies available by current or later existing laws.
23. **Entire Agreement.** This Lease sets forth all of the covenants, promises, agreements, conditions and understandings between Lessor and Lessee governing the Premises. There are no covenants, promises, agreements, conditions, and understandings, either oral or written, between them other than those herein set forth. Except as herein provided, no subsequent alterations, amendments, changes, or additions to this Lease shall be binding upon the Lessor or Lessee unless and until reduced to writing and signed by both parties.
24. **Notices.** All notice, demands, and other communications required hereunder shall be in writing and shall be given by first class mail, postage prepaid, registered or certified mail, return receipt requested; if addressed to Lessor, to:  
State of Maine, Department of Agriculture, Conservation and Forestry, Division of Parks and Lands,  
22 State House Station, Augusta, ME 04333-0022, Attn: Director;  
and if to Lessee, to;  
Central Maine Power Company, Real Estate Services  
83 Edison Drive, Augusta, Maine 04364, Attn. Supervisor, Real Estate
25. **General Provisions:**
- a. **Governing Law.** This Lease shall be construed and interpreted in accordance with the laws of the State of Maine.
- b. **Savings Clause.** The invalidity or unenforceability of any provision of this Lease shall not affect or impair the validity of any other provision. To the extent any provision herein is inconsistent with applicable state statute, the statute is deemed to govern.
- c. **Paragraph Headings.** The paragraph titles herein are for convenience only and do not define, limit, or construe the contents of such paragraph.

IN WITNESS WHEREOF, the parties have hereunto set their hands the day and year first above written. For purposes of this Lease, a facsimile signature shall be deemed an original.

Lessor:

**STATE OF MAINE**  
Department of Agriculture, Conservation, and Forestry  
Bureau of Parks and Lands

By: \_\_\_\_\_  
Thomas Morrison Acting Director

Dated: \_\_\_\_\_, 2014

\_\_\_\_\_  
Witness

Lessee:

**CENTRAL MAINE POWER COMPANY**

BY: Mary R. Smith  
Mary R. Smith, Authorized Representative

Dated: 12-8-14

Roberta B. Holahan  
Witness

ROBERTA B. HOLAHAN  
Notary Public, State of New York  
No. 01HO8040322  
Qualified in Monroe County  
Commission Expires April 17, 2018

**EXHIBIT A**

**Leased Premises  
Department of Agriculture, Conservation and Forestry  
Bureau of Parks and Lands  
and  
Central Maine Power Company**

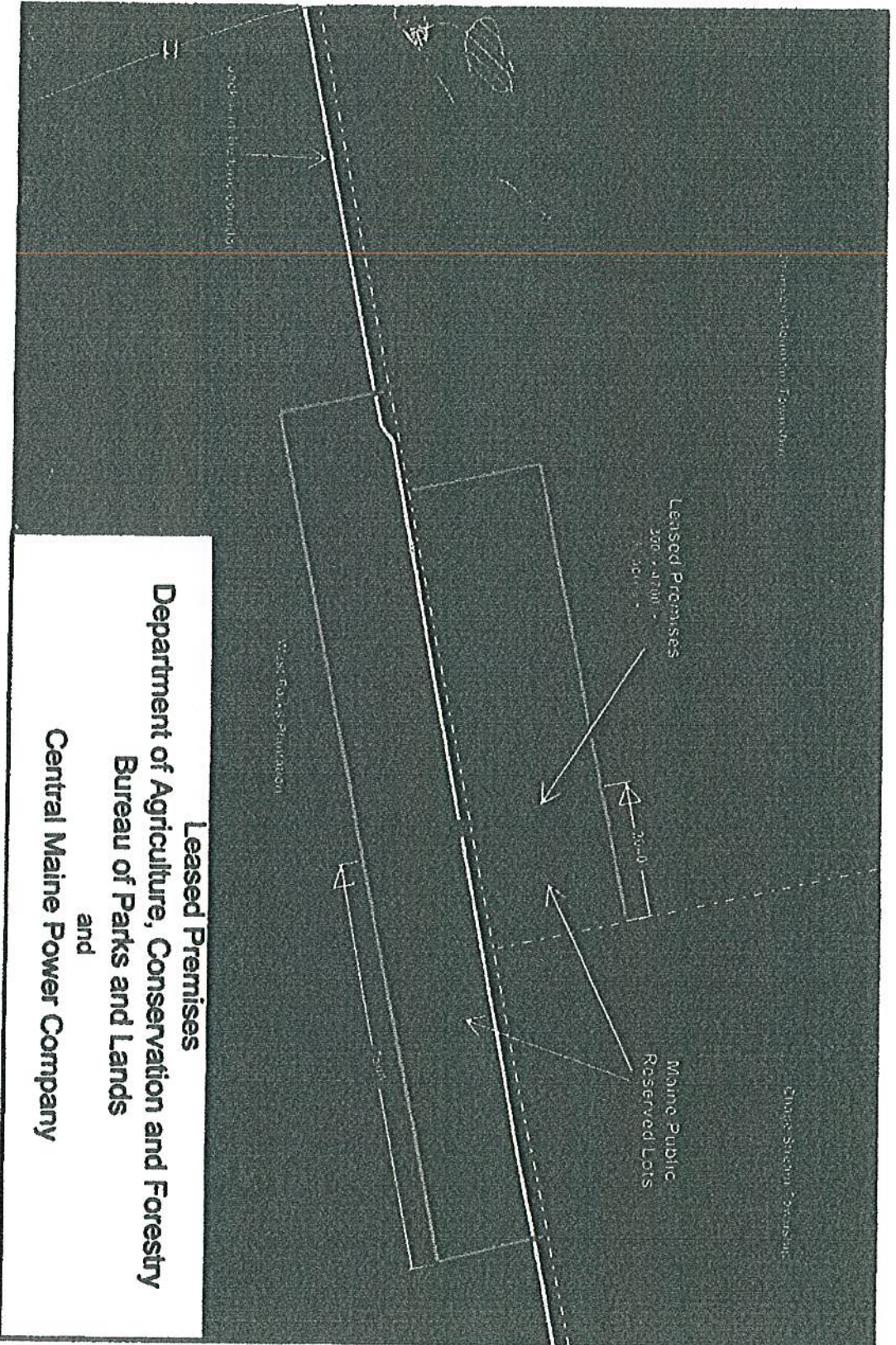
**A non-exclusive lease over a portion of the Lessor's land located in Johnson Mountain Township (T2 R6 BKP WKR), and West Forks Plantation, Somerset County, Maine, more particularly described as follows:**

**A strip of land 300 feet in width beginning at the southerly line of the Maine Public Reserved Lot located on the northerly line of West Forks Plantation and extending northerly a distance of 4700 feet, more or less, to the northerly line of the Maine Public Reserved Lot located on the common line between West Forks Plantation and Johnson Mountain Township (T2 R6 BKP WKR). The centerline of said strip beginning at a point on the southerly line of the Lessor's land at a point that is 7,500 feet westerly of the southeasterly corner of said Lot in West Forks Plantation; thence on a bearing of 342.2 degrees a distance of 4,700 feet, more or less, to a point on the northerly line of said Lot in Johnson Mountain Township, said point being 2640 feet, more or less, westerly of the northeast corner of said Lot and the east line of Johnson Mountain Township; said leased area containing 33 acres, more or less (the "Leased Premises").**

**The description of the Leased Premises is based on a current conceptual design of the Lessee's proposed transmission line corridor and may be subject to modification by Lessee to minimize impacts on environmentally sensitive areas. Lessor and Lessee agree that upon completion of environmental assessments, final engineering, and if applicable, any survey prepared by Lessee, Lessee will prepare a final description of the Leased Premises to be incorporated into this Lease. Lessor and Lessee further agree that the final alignment of the transmission line corridor will be substantially as described herein and any significant deviation from the above described line will be agreed to in writing by Lessor and Lessee.**

**Seller's Initials \_\_\_\_\_**

**Exhibit B**



LEASE AMENDMENT

This Amendment to the Lease is made as of this 11 day of June, 2015 (Effective Date) between the Department of Agriculture, Conservation and Forestry Bureau of Parks and Lands, ("Lessor") and Central Maine Power Company, a Maine corporation with an office at 83 Edison Drive, Augusta, Maine 04336 ("Lessee").

WITNESSETH

WHEREAS, Lessor and Lessee (collectively, the Parties) entered into a certain Lease (Lease) effective December 8, 2014 to lease a portion of the Lessor's land located in the West Forks Plantation and Johnson Mountain Township (T2 R6 BKP WKR) Maine Public Reserved Lands in Somerset County, Maine ("Premises") to be developed and used as a transmission line corridor and;

WHEREAS, at lease execution, Lessee initially agreed to pay to the Lessor an annual base year lease payment (Year One) of \$1,400.00; which shall be adjusted each subsequent lease year in an amount not to exceed the average increase in the Consumer Price Index, as published by the Bureau of Labor Statistics, United States Department of Labor.

NOW THEREFORE, the Parties agree to amend the Lease as follows.

- 1) The initial Year One annual (base year) lease payment shall be increased from \$1,400.00 to \$3,680.00.

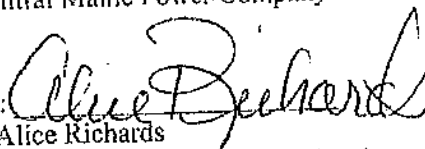
Except as specifically amended herein, all terms and conditions of the original Lease shall remain in full force and effect including the annual lease payment shall continue to be adjusted each year in an amount not to exceed the average increase in the Consumer Price Index, as published by the Bureau of Labor Statistics, United States Department of Labor over the preceding one year period.

IN WITNESS WHEREOF, The parties hereto have caused this Amendment to Lease to be executed by its duly authorized agent as of the date first written above.

LESSEE:

Central Maine Power Company

By:


  
Alice Richards

Its: Supervisor, Real Estate Services

LESSOR:

State of Maine  
Department of Agriculture,  
Conservation and Forestry  
Bureau of Parks and Lands

By:

  
Walter E. Whitcomb

Its: Commissioner



*Amendment Agreement* X

**LEASE AMENDMENT**

This Amendment to the Lease is made as of this 11 day of June, 2015 (Effective Date) between the Department of Agriculture, Conservation and Forestry Bureau of Parks and Lands, ("Lessor") and Central Maine Power Company, a Maine corporation with an office at 83 Edison Drive, Augusta, Maine 04336 ("Lessee").

WITNESSETH

WHEREAS, Lessor and Lessee (collectively, the Parties) entered into a certain Lease (Lease) effective December 8, 2014 to lease a portion of the Lessor's land located in the West Forks Plantation and Johnson Mountain Township (T2 R6 BKP WKR) Maine Public Reserved Lands in Somerset County, Maine ("Premises") to be developed and used as a transmission line corridor and;

WHEREAS, at lease execution, Lessee initially agreed to pay to the Lessor an annual base year lease payment (Year One) of \$1,400.00; which shall be adjusted each subsequent lease year in an amount not to exceed the average increase in the Consumer Price Index, as published by the Bureau of Labor Statistics, United States Department of Labor.

NOW THEREFORE, the Parties agree to amend the Lease as follows.

- I) The initial Year One annual (base year) lease payment shall be increased from \$1,400.00 to \$3,680.00.

Except as specifically amended herein, all terms and conditions of the original Lease shall remain in full force and effect including the annual lease payment shall continue to be adjusted each year in an amount not to exceed the average increase in the Consumer Price Index, as published by the Bureau of Labor Statistics, United States Department of Labor over the preceding one year period.

IN WITNESS WHEREOF, The parties hereto have caused this Amendment to Lease to be executed by its duly authorized agent as of the date first written above.

**LESSEE:**

Central Maine Power Company

By:   
Alice Richards  
Its: Supervisor, Real Estate Services

**LESSOR:**

State of Maine  
Department of Agriculture,  
Conservation and Forestry  
Bureau of Parks and Lands

B \_\_\_\_\_  
Walter E. Whitcomb  
Its: Commissioner

## SENATE

JAMES F. DILL, DISTRICT 5, CHAIR  
 G. WILLIAM DIAMOND, DISTRICT 26  
 RUSSELL BLACK, DISTRICT 17

KAREN S. NADEAU, LEGISLATIVE ANALYST  
 CHERYL MCGOWAN, COMMITTEE CLERK



## HOUSE

CRAIG V. HICKMAN, WINTHROP, CHAIR  
 DAVID HAROLD MCCREA, FORT FAIRFIELD  
 MARGARET M. O'NEIL, SACO  
 CHLOE S. MAXMIN, NOBLEBORO  
 TIFFANY ROBERTS-LOVELL, SOUTH BERWICK  
 MARYANNE KINNEY, KNOX  
 THOMAS H. SKOLFIELD, WELD  
 RANDALL C. HALL, WILTON  
 THEODORE JOSEPH KRYZAK, JR., ACTON  
 WILLIAM D. PLUECKER, WARREN

STATE OF MAINE  
 ONE HUNDRED AND TWENTY-NINTH LEGISLATURE  
 COMMITTEE ON AGRICULTURE, CONSERVATION AND FORESTRY

January 30, 2020

Andy Cutko, Director  
 Bureau of Parks and Lands  
 Department of Agriculture, Conservation and Forestry  
 22 State House Station  
 Augusta, ME 04333-0022

Dear Director Cutko,

As you know, the Joint Standing Committee on Agriculture, Conservation and Forestry (ACF Committee) held a public hearing on Tuesday, January 21st for LD 1893, "An Act To Require a Lease of Public Lands To Be Based on Reasonable Market Value and To Require Approval of Such Leases for Commercial Purposes."

At the public hearing it became evident that LD 1893 was introduced to address concerns relating to the lease of public lands to Central Maine Power (CMP) for a transmission line through western Maine. This legislation also raises the question of whether the lease agreement between the State and CMP required approval by two-thirds of the Legislature. Article IX, Section 23 of the Constitution of Maine states:

*State park land, public lots or other real estate held by the State for conservation or recreation purposes and designated by legislation implementing this section may not be reduced or its uses substantially altered except on the vote of 2/3 of all the members elected to each House.*

As you know, at the public hearing last week, we requested that you provide the ACF Committee with relevant documents and communications regarding the lease of public lands to CMP. Please include documents and communications, including emails and handwritten notes or notations, among or between staff in the Bureau of Parks and Lands, the Bureau of Forestry, the Office of the Commissioner, the Office of the Attorney General, the Office of the Governor, and representatives of CMP. More specifically, we are interested in any materials from January 1, 2013 through January 1, 2016 and after July 1, 2018 relating to the determination that the lease of public lands on the West Forks Plantation and Johnson Mountain Township in Somerset County by CMP did not constitute a reduction or substantial alteration of those lands and, therefore, did not require a two-thirds vote of the Legislature.

(over)

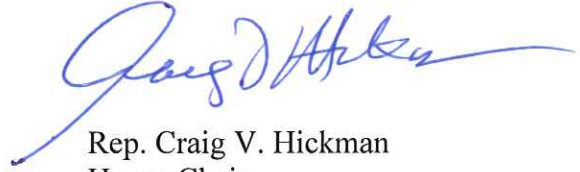


It is our understanding that the public records search will require approximately 40 staff hours. With this in mind, we respectfully request that you complete this search by Friday, February 14<sup>th</sup>.

Sincerely,



Sen. James F. Dill  
Senate Chair



Rep. Craig V. Hickman  
House Chair

cc: Members, Joint Standing Committee on Agriculture, Conservation and Forestry  
Amanda Beal, Commissioner, Department of Agriculture, Conservation and Forestry  
Emily Horton, Department of Agriculture, Conservation and Forestry



STATE OF MAINE  
DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY  
BUREAU OF PARKS AND LANDS  
22 STATE HOUSE STATION  
AUGUSTA, MAINE 04333

JANET T. MILLS  
GOVERNOR

AMANDA E. BEAL  
COMMISSIONER

February 14, 2020

Senator James F. Dill, Chair  
Representative Craig Hickman, Chair  
Committee on Agriculture, Conservation and Forestry  
100 State House Station  
Augusta, Maine 04333-0100

Dear Senator Dill and Representative Hickman,

In response to your request of January 30, 2020, regarding the Bureau's lease to CMP of public reserved lands in West Forks Plantation and Johnson Mountain Township, the Bureau has searched its e-mail records, digital files, and paper files, and found the following responsive documents:

- 1) A document titled "Considerations for locating a CMP Right of Way across BPL Lands in West Forks PLT. and Johnson Mt. TWP." This document was located in a digital file accessible to a number of BPL staff. The date on the digital file was August 25, 2014. I should note that the document's reference to 12 M.R.S. § 1852(4) mistakenly provides that the Governor's and Commissioner's consent is required. 12 M.R.S. § 1852(4) does not require consent of the Governor or Commissioner to approve a lease.
- 2) An e-mail dated July 9, 2014 from DACF Commissioner Walt Whitcomb to BPL Director Tom Morrison referencing correspondence with the Governor's Energy Office.
- 3) A document titled "CMP Lease Amendment: Summary 3-17-15." This document was also located in a digital file accessible to several BPL staff, and it summarizes the financial terms of the lease and amendment.

Director of Real Property Management David Rodrigues and I will be available at the work session to discuss questions related to these documents, to the extent that our knowledge of these documents and associated issues permit.

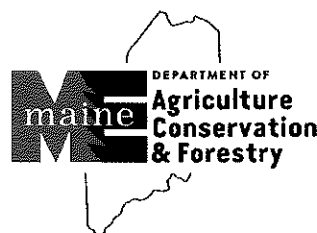
Sincerely,

A handwritten signature in black ink, appearing to read "Andy Cutko".

Andy Cutko

Cc: Commissioner Amanda Beal, DACF  
Emily Horton, DACF  
Karen Nadeau, Legislative Analyst

ANDREW R. CUTKO, DIRECTOR  
BUREAU OF PARKS AND LANDS  
18 ELKINS LANE, HARLOW BUILDING



PHONE: (207) 287-3821  
FAX: (207) 287-6170  
WEB: WWW.MAINE.GOV/DACF

**Cutko, Andy**

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**From:** Eastman, Kathy on behalf of Whitcomb, Walt  
**Sent:** Wednesday, July 9, 2014 8:45 AM  
**To:** Morrison, Tom  
**Subject:** FW: Land Follow Up  
**Attachments:** GoogleEarth\_Image.jpg

-----Original Message-----

From: Woodcock, Patrick C  
Sent: Tuesday, July 01, 2014 9:39 AM  
To: Whitcomb, Walt  
Subject: FW: Land Follow Up

Commissioner Whitcomb,  
This is the parcel that I discussed this morning. I would appreciate you taking a look to see if you could work to accommodate this request.  
Patrick

Patrick C. Woodcock  
Governor's Energy Office – Maine

-----Original Message-----

From: Harrington M, Joel [mailto:Joel.Harrington@cmpco.com]  
Sent: Monday, June 23, 2014 8:20 AM  
To: Woodcock, Patrick C  
Subject: Land Follow Up

Patrick,

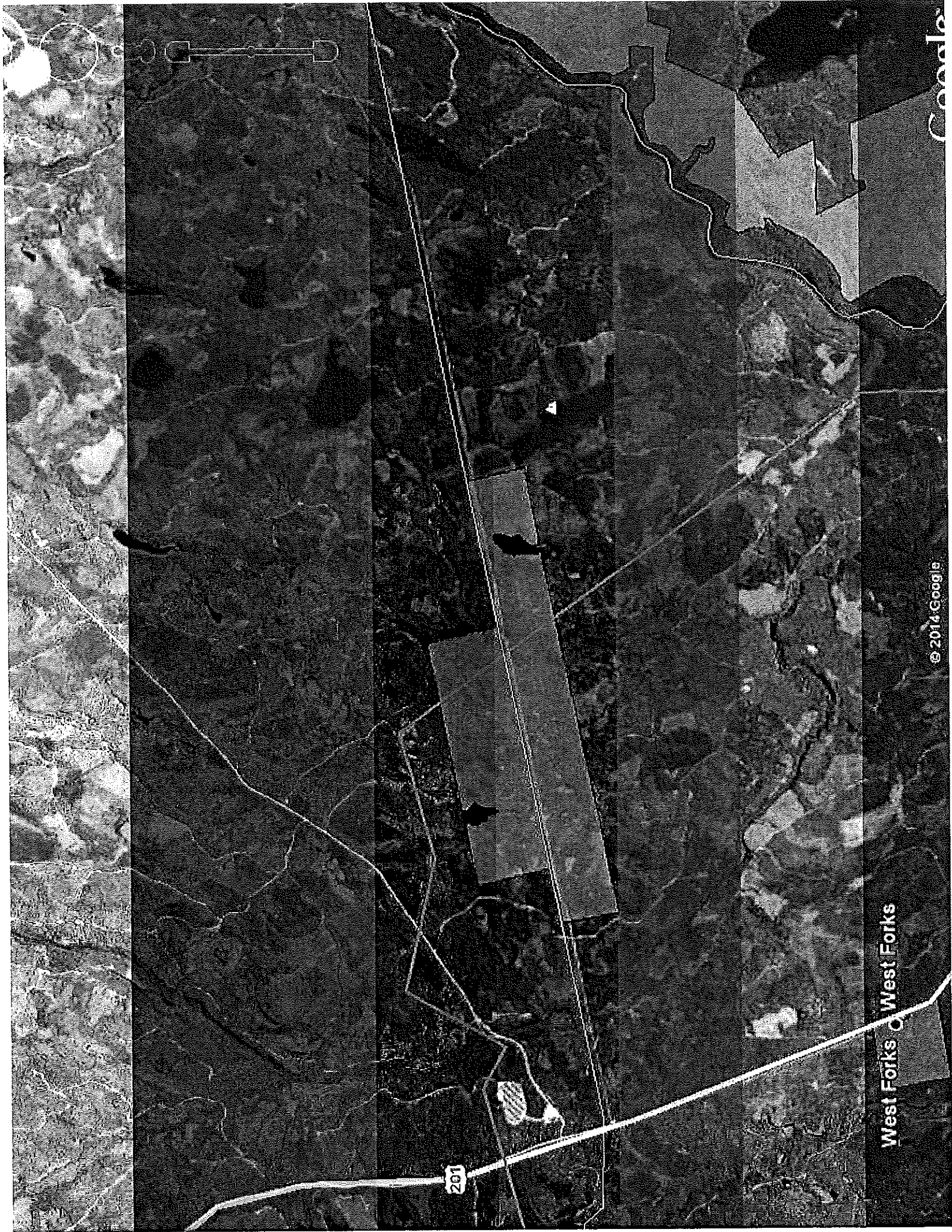
Here is the specific parcel we discussed last week.

Joel  
Sent via my BlackBerry mobile device

----- Original Message -----

From: Freye, Kenneth H  
Sent: Thursday, June 19, 2014 06:41 PM  
To: Harrington M, Joel; Dickinson, Thorn  
Cc: Sawyer, William M.  
Subject: Google Earth Image

Joel,  
The parcels are the public lot in Johnson Mountain (State ID 168-150) and the public lot in West Forks Plantation (State ID 205-352). They are the parcels on the attached aerial that are bisected by the purple line, the proposed centerline for the HVDC line. Let me know if you need more information.  
Ken



West Forks of West Forks

© 2014 Google

Cooper

### Considerations for locating a CMP Right of Way across BPL Lands in West Forks Plt and Johnson Mt. Plt

1. Authority to grant ROW across existing public lots (Johnson Mountain Twp Lot and West Forks Plt. Lot):

BPL can grant a right of way through its Public Reserved Lands through two statutory authorities:

- a. 12 MRSA Section 1852, subsection 4, allows the bureau to lease public reserved lands for utilities rights-of-way for a term not exceeding 25 years; with the consent of the Governor and the Commissioner.
- b. 12 MRSA Section 1851 allows the bureau to execute deeds to convey lands, subject to the approval of the Legislature (by a two-thirds vote pursuant to 12 MRSA Section 598-A).

Note on Routing: There is already a lease to CMP for a power line corridor across the northern border of the West Forks Plt. Lot. That corridor extends all the way to Route 201, with an existing crossing of Cold Stream. It appears to be about 100 feet wide at most. The Bureau looked at this as a potential alternative route, and concluded that the net new acreage of ROW across current state ownership would appear to be about the same. Because of impacts related to crossing of Cold Stream, as discussed below, this option was not viewed as preferable to the proposed alignment.




2. Pending Cold Stream Forest Acquisition: The proposed corridor route would cross a portion of a property that is intended for BPL acquisition, with implications for both the routing and options for the conveyance of a right of way or deed. The Cold Stream Forest Project is a Forest Legacy Project which will entail BPL acquisition of lands along Cold Stream and its headwater ponds in order to protect important brook trout and deer habitat. See the attached map. This planned acquisition would occur in 2015. Forest Legacy funds in the amount of \$6 million have been approved for this project, and an additional \$1.5 million is requested from the Land for Maine's Future program, currently in the process of determining the use of voter approved bond for a round of proposals submitted earlier this spring. The Cold Stream Forest Project is LMF's highest ranked project.

Conveyance considerations related to the Cold Stream Forest Acquisition: The proposed route would cross about 0.2 mile of the Cold Stream Forest lands expected to come under state ownership. Once the property is acquired with Forest Legacy and LMF funds, there would be significantly more complication in making a conveyance of the property, or a power line corridor lease. To avoid this, the Bureau proposes to work with Plum Creek, and the Trust for Public Land (which holds a purchase option on the property), to exclude the proposed corridor from the acquisition property.

Routing Considerations: Regarding the routing, additional analysis would be needed, but It does appear that where the proposed corridor crosses Cold Stream near the Capital Road might minimize new clearing needed, reducing potential impacts of loss of shade and warm runoff, as well as visual impacts on the stream corridor. The Bureau would ask that the crossing involve as little width and clearing as possible, for these reasons. The Bureau, TPL and Plum Creek, the present landowner, would need to understand what is needed for this crossing in order to adjust the project accordingly. There was already a small buffer of land excluded from the project around the Capital Road – the question is, how much more is needed?





-  Cold Stream Project
-  State Lands
-  Private Conserved Lands

## Cold Stream Project South

Johnson Mountain TWP, Parlin Pond Twp  
Moxie Gore & West Forks Plt, ME

Boundaries are approximate. Created by The Trust for Public Land on 8/1/2013. Information on this map is provided for purposes of discussion and visualization only.



Proposed CMP Power Line ROW

201

West Forks  
West Forks

© 2014 Google

Google



CMP Lease Amendment

SUMMARY

3-17-15

- On December 15, 2014, DACF entered into a 25 year utility line lease with CMP for a new transmission line on Maine Public Reserved Lands in West Forks Plantation and Johnson Mountain Township.
- The lease had an estimated rent of \$1,400 which was paid by CMP at the time the lease was signed.
- Section 2 of the lease required an appraisal to be done within 12 months of the lease signing to determine what the rent should be. CMP paid for the appraisal.
- CMP had the appraisal completed in early spring of 2015 and the appraisal determined the rent to be \$3,680 for the first year.
- The attached Lease Amendment reflects the change in rent from \$1,400 to \$3,680 for the first year of rent.
- CMP has paid the rental increase of \$2,280 and is paid in full for the 2015 rental year.



Hager: Testimony to Army Corps of Engineers on Hydro-Québec's carbon footprint, Dec. 5, 2019

Good afternoon. I very much appreciate the chance to put on record the surprisingly large published estimates of the negative climate impact of Hydro-Quebec's energy.

My name is Brad Hager. I am a Professor of Earth Sciences at the Massachusetts Institute of Technology, where I co-direct one of MIT's Low Carbon Energy Centers. I split my time between Massachusetts and our home in Mercer, Maine. I am also an avid outdoorsman – over the years my family and I have spent about 10 months on canoe trips on the rivers of northern Quebec. I worry about the planet that our children will inherit and I am especially concerned about continued growth in carbon emissions.

Over the past decade, scientists have recognized the surprisingly large emissions of carbon dioxide and methane by some hydro-power facilities. Studies published recently in the peer reviewed scientific literature<sup>1</sup> document the greenhouse gas emissions of approximately 1,500 hydro facilities, including most of those providing power to Hydro Québec.

To summarize what I will present in more detail:

- 1) There is an extremely wide range of greenhouse gas emissions from hydro facilities. Six of Hydro Québec's reservoirs are among the top 25% of greenhouse gas emitters of hydro plants worldwide. Their emissions range from about that of a modern natural gas power plant to over twice that of coal power plants. They are definitively NOT the source of green power that they are made out to be.
- 2) Why are Hydro-Québec's reservoirs so dirty? Hydro-Québec's reservoirs are nothing like the clean reservoirs of Switzerland that dam deep, narrow valleys above tree line. Rather, Hydro-Québec's reservoirs flood vast tracts of low-lying woodlands, resulting in deforestation akin to that we see in the alarming images of burning the Amazon. In addition, the greenhouse gas emissions from decay of submerged trees and disturbed soils in newly created reservoirs are twice as high as decades-old ones, so building new reservoirs to provide power for export leads to particularly high emissions in the first 5 – 10 years of reservoir life.

Given the fact that Hydro-Québec's high greenhouse gas emissions are documented in the peer reviewed literature, it seems dereliction of duty to allow NECEC to proceed without serious and formal federal review. NECEC's negative impacts on the climate must be considered in the permitting process.

The bar chart on the next page shows the range of carbon footprints for common power sources. The numbers on the vertical axis give the greenhouse gas impact per MWh of energy

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<sup>1</sup> Barros, N.; Cole, J. J.; Tranvik, L. J.; Prairie, Y. T.; Bastviken, D.; Huszar, V. L.; Del Giorgio, P.; Roland, F. Carbon emission from hydroelectric reservoirs linked to reservoir age and latitude. *Nat. Geosci.* 2011, 4 (9), 593.

Teodoru CR, Bastien J, Bonneville M, Giorgio PA, Demarty M, Garneau M, et al. The net carbon footprint of a newly created boreal hydroelectric reservoir. *Glob Biogeochem Cycles.* 2012; 26 (2), 4187 DOI: 10.1029/2011GB004187. (Referred to as "Quebec study:" One author is from Hydro-Québec.)

Scherer, L.; Pfister, S. Hydropower's biogenic carbon footprint. *PLoS One.* 2016, 11 (9), No. e0161947. (Referred to as "Swiss study.")

Ocko, I. B, and Hamburg, S. P. Climate Impacts of Hydropower: Enormous Differences among Facilities and over Time. *Environ. Sci. Tech.* 2019 doi: 10.1021/acs.est.9b05083.

Hager: Testimony to Army Corps of Engineers on Hydro-Québec's carbon footprint, Dec. 5, 2019

generated. The bars show the ranges from various sources, ranging from the dirtiest on the left – coal – to the cleanest on the right – wind and nuclear. In the middle, with the largest range by far, is hydropower. Note that 10% of the world's hydro has a footprint that plots off the top of this chart.

Where does Hydro Québec fit in this wide range? Hydro Québec emissions documented in the Swiss global study are shown in black font. Note that the Caniapiscau dam, which makes the largest lake in Québec, has *twice* the carbon footprint of coal! This is hardly clean energy. And 5 more reservoirs have footprints higher than modern natural gas plants. Only 1 small Hydro Québec reservoir is as clean as wind.

The range in values for the detailed Québec Eastmain-1 study are shown in red. After the initial flooding, emissions were above modern gas, approaching coal. After a decade, they drop off to a value about half that of gas, with the crossover after about 5 years.

The sketch of a watershed in the final figure provides an intuitive understanding of the wide range in variation of hydro's carbon footprint. Deep reservoirs in narrow mountain valleys with little vegetation (think Switzerland or Iceland) are clean. Shallow lowland reservoirs that flood vast areas of forest (think Hydro-Québec) are dirty.

In summary, the carbon footprints of Hydro-Québec's power as documented in the peer-reviewed scientific literature make it among the dirtiest hydro in the world. In view of this published science, it would be irresponsible to grant a license for NECEC without a thorough Environmental Impact Assessment that considers its negative effects on the climate and the environment.

Thank you for the opportunity to testify.

Bradford H. Hager  
Cecil and Ida Green Professor of Earth Sciences  
Massachusetts Institute of Technology  
[bhhager@mit.edu](mailto:bhhager@mit.edu)

Somerville, MA and Mercer, ME

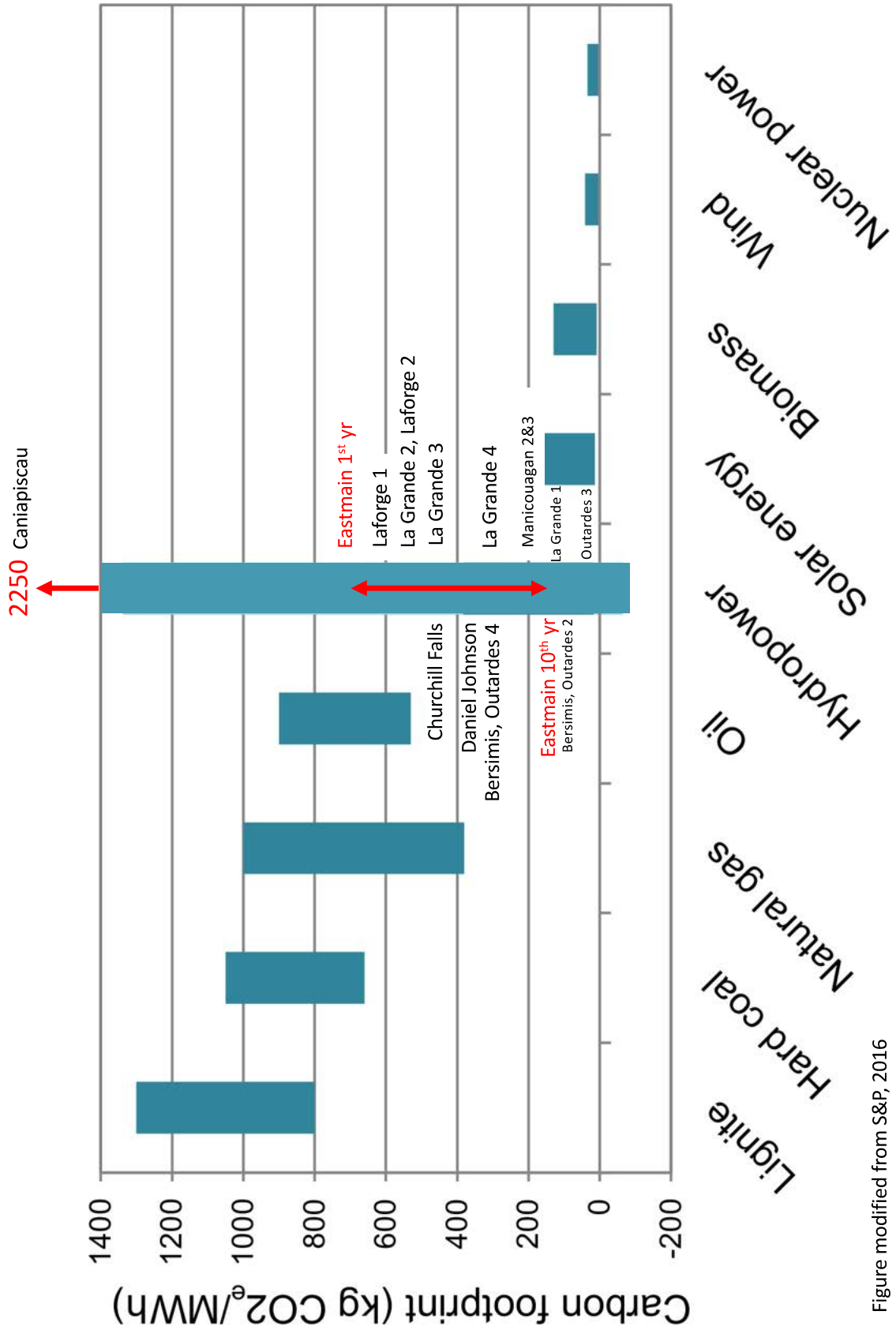


Figure modified from S&P, 2016  
 Black text – HQ emissions from S&P 2016  
 Red text – emissions from Q. 2012

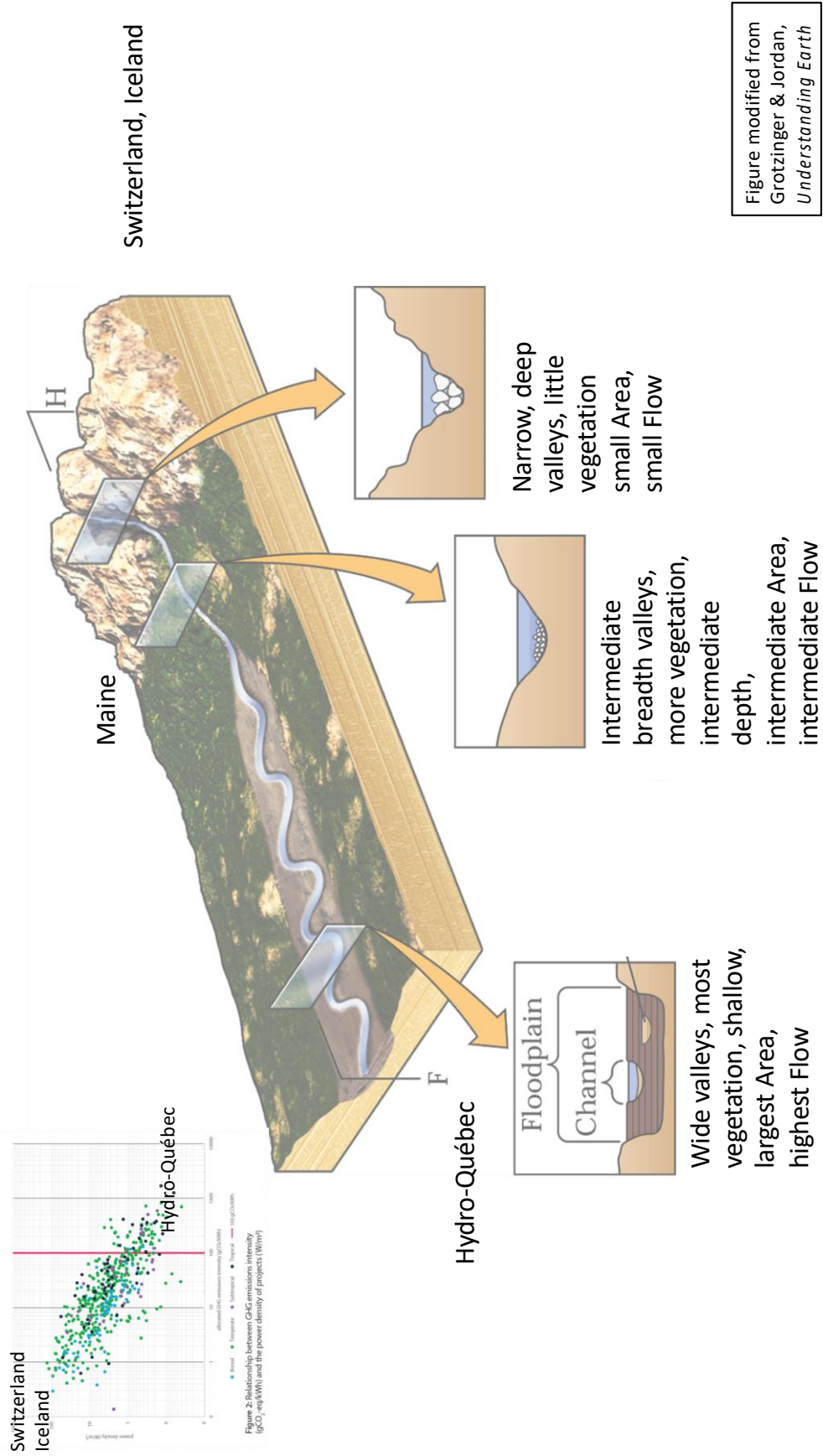


Figure modified from Grotzinger & Jordan, *Understanding Earth*

## Documentation of the Carbon Footprint of Hydro Québec's Hydropower

Bradford H. Hager  
Cecil and Ida Green Professor of Earth Sciences  
Department of Earth, Atmospheric and Planetary Sciences  
Massachusetts Institute of Technology

### *Summary*

The purpose for building NECEC is to provide a conduit for ~ 10 TWh/yr of electricity to Massachusetts. The premise used to justify NECEC is that this power would result in much less net emission of greenhouse gasses than what would be produced from electricity generated using modern natural gas power plants (~ 400 g CO<sub>2</sub>/kWh). Yet despite claims that its power is “low-carbon,” Hydro Québec (HQ) has provided no formal documentation of this claim.

In this white paper I provide relevant references, as well as giving a road map through these references to finding values of CO<sub>2</sub>e emissions of HQ reservoirs. The information in the peer-reviewed literature demonstrates that a large fraction of HQ power is not low carbon.

A growing number of peer-reviewed articles in the scientific literature address the carbon footprint of hydro reservoirs worldwide. By studying these papers and the on-line supplementary materials accompanying them, I have assembled sufficient information to determine the greenhouse gas emissions of 18 of HQ's major reservoirs – those that generate in excess of 1 TWh/yr of electricity each. There is a tremendous range in HQ emissions – from 5 g CO<sub>2</sub>/kWh (half that produced by wind) to 2265 g CO<sub>2</sub>/kWh (twice that produced by coal). About half of HQ generation is comparable in emissions to natural gas. These estimates are given in a table and illustrated in a figure in the final two pages of this document.

### *Relevant literature*

About 20 years ago, scientists began to recognize the possibility that reservoir greenhouse gas emissions are significant (e. g., St. Louis et al., 2000). In particular, HQ undertook an extensive research program to measure the fluxes of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O in their reservoirs and surroundings. Tremblay et al. (2005) published measurements of greenhouse gas fluxes for many Canadian reservoirs, including most existing HQ reservoirs. Fluxes were reported in mg/m<sup>2</sup>/d. (There is tremendous scatter in the observations for a given reservoir because emissions vary greatly in space and time. The standard deviation of the values reported are approximately equal to the values themselves.)

Teodoru et al. (2012) measured variations in emissions as a function of time over the three years following the filling in 2006 of the new Eastmain-1 reservoir in Québec. They found that

initially the CO<sub>2</sub> footprint was comparable to a coal fired power plant, but decreased to that of a modern gas plant after 3 years. They extrapolated the data to conclude that, over 100 years, the cumulative emissions of this reservoir would be about half that of a gas plant

Barros et al. (2011) compiled data from about 100 hydro reservoirs worldwide, concluding that emissions were correlated with reservoir age and latitude. His data set included Tremblay's (2005) data.

Hertwich (2013) made an important advance by making estimates from the web of the amount of energy generated by these reservoirs. This made it possible to convert the conventional measurements of emissions per unit area to obtain emissions per kWh.

Scherer and Pfister (2016) used the ~150 reservoirs in the Hertwich (2013) data set to fit a general linearized model, explaining most of the CO<sub>2</sub> emission variation using only two variables: Hertwich's area/electricity ratio and the logarithm of reservoir area. They then used the recently developed Global Reservoir and Dam Database (GRAND, see Lehner et al., 2011) to estimate model-based fluxes for ~ 1500 reservoirs worldwide. The supplementary data files of Scherer and Pfister (2016) provide a convenient source for the Hertwich (2013) data set, as well as an alternative estimate (from GRAND) for energy generation in 2009.

Deemer et al. (2016) also augmented the Barros et al (2011) data set with more recent measurements. However, they focused on reservoirs where methane is the main greenhouse gas, and their study does not add substantially to information about HQ reservoirs.

#### *Estimates of Hydro Québec CO<sub>2</sub>e footprint*

Table 1 gives estimates, using four approaches, for the CO<sub>2</sub> equivalent emissions (g CO<sub>2</sub>e/kWh) for the 18 HQ reservoirs generating > 1 TWh/yr. Because generation by any power plant varies from year to year, there are two estimates used: H13 is the older value provided by Hertwich (2013), while S&P is the value for 2009 provided by Scherer and Pfister, 2013. Systems are ranked by using the larger of these two values. (Note that the H13 value for the Robert-Bourassa system is anomalously large, and not in line with others in the La Grande system, making me skeptical of this value.)

The values of CO<sub>2</sub>e (g/kWh) in the columns labeled "S&P data" were calculated using the two estimates of energy (in TWh) with data for reservoir emissions in the Scherer and Pfister (2016) table. The "S&P model" column gives Scherer and Pfister's (2016) values for their two-parameter model. The "T12 data" gives Teodoru et al.'s (2012) observed emissions for the Eastmain-1 reservoir in 2009, three years after it was flooded. Cells where there was no information are left blank. Cells where greenhouse gas emissions exceed that of natural gas are highlighted in yellow. Cells where greenhouse gas emissions exceed that of coal are highlighted in red.

Even though HQ's two top power producers, Robert-Bourassa and Churchill Falls, are over 40 years old, they both have carbon footprints approximately equal to that of modern natural gas. Brisay/Caniapiscau is two times dirtier than coal. Most of HQ's power has a much greater carbon emissions than wind.

Table 1: Estimates of CO2e for Hydro Québec's reservoirs > 1 TWh/yr

System	Area (km2)	TWh			CO2e g/kWh			
		Max	H13	S&P	S&P data H13 TWh	S&P data S&P TWh	S&P model S&P TWh	T12 data H13 TWh
Robert-Bourassa (La Grande-2)	2835	37.4	37.4	5.2	57	412	576	
Churchill Falls*	4816	30.8		30.8			436	
Bersimis	798	12.5	12.5	7.8	35	56	313	
La Grande 4	765	10.1	10.1	8.9	46	52	309	
Manic 5	1973	9.8	9.8		124			
La Grande 3	2420	8.7	8.7	8.4	210	217	451	
La Grande 2A	2835	7.1	7.1		222			
Manic 2	124	6.5	5.1	6.5	10	8	180	
Manic 3	236	5.8	4.9	5.8	6	5	219	
Bersimis 2	38	5.5		5.5			119	
La Grande 1	70	4.5	4.5	2.7	12	20	165	
Outardes 3	11	4.5	3.2	4.5			42	
Outardes 4	625	3.7	2.6	3.7	194	138	329	
Laforge-1	960	2.7	2.7	1.7	371	588	605	
Eastmain-1	600	2.7	2.7		309			275
St-Marguerite 3	253	2.6	2.6		197			
Outardes 2	26	2.0		2.0			102	
Brisay/Caniapiscau	4318	1.2	1.2	0.8	1501	2265	2250	

\* Churchill Falls is in Labrador, but almost all of its power goes to HQ.

Figure 1 illustrates the range of estimates for these reservoirs in a bar graph. For reference, the line showing 400 g CO<sub>2</sub>e/kWh is the value for a modern natural gas power plant.

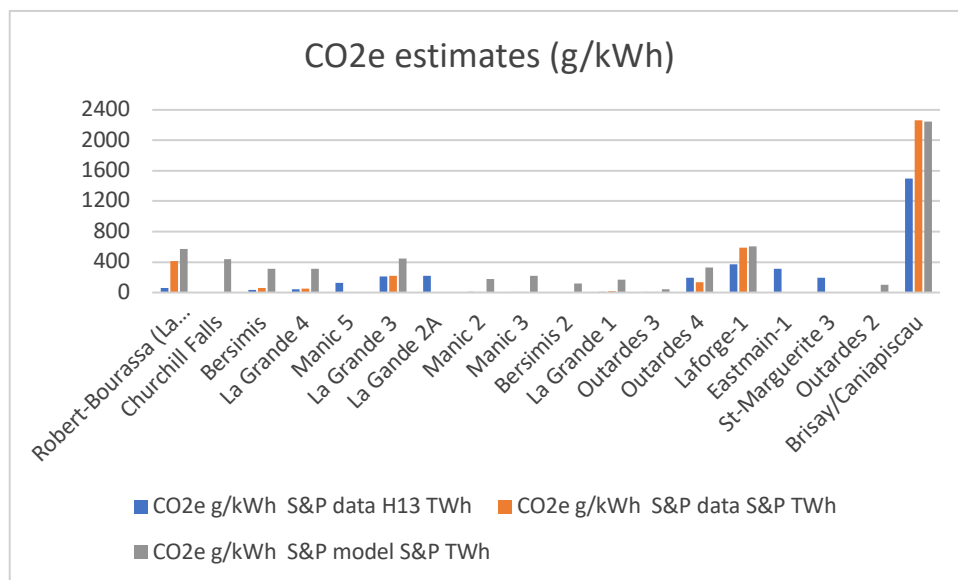


Figure 1: CO<sub>2</sub>e (g/kWh) estimates for HQ's reservoirs generating > 1 TW/y.

## References

- Barros, N.; Cole, J. J.; Tranvik, L. J.; Prairie, Y. T.; Bastviken, D.; Huszar, V. L.; Del Giorgio, P.; Roland, F. Carbon emission from hydroelectric reservoirs linked to reservoir age and latitude. *Nat.Geosci.* 2011, 4 (9), 593.
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