TOWN OF DURHAM
15 NEWMARKET ROAD
DURHAM, NH 03824-2898
Tel: 603/868-5571
Fax: 603/868-5572

AGENDA

DURHAM TOWN COUNCIL

MONDAY, OCTOBER 1, 2012
DURHAM TOWN HALL – COUNCIL CHAMBERS
7:00 PM

NOTE: ***THE TOWN OF DURHAM REQUIRES 48 HOURS NOTICE IF SPECIAL COMMUNICATION AIDS ARE NEEDED***

I. Call to Order

II. Approval of Agenda

III. Special Announcements

IV. Approval of Minutes – None

V. Councilor and Town Administrator Roundtable

VI. Public Comments ***(Not earlier than 7:45 PM)***

VII. Unanimous Consent Agenda *(Requires unanimous approval. Individual items may be removed by any councilor for separate discussion and vote)*

A. Shall the Town Council schedule a public hearing for Monday, October 15, 2012 on a resolution amending Resolution #2012-11 to: 1) Change the $745,000 funding designation within the 2012 Capital Fund Budget to come from short-term borrowing rather than the Undesignated (Unassigned) Fund Balance; and 2) Authorizing the short-term borrowing of said $745,000 for up to one year to purchase the People's United Bank building located at 8 Newmarket Road for use as the future Town Hall?

B. Shall the Town Council, upon recommendation of auditors Plodzik & Sanderson and the Administrator, adopt the Town's revised General Fund-Fund Balance Policy?

C. Shall the Town Council endorse a letter of support for the Strafford Regional Planning Commission to apply for local source water protection grants through the NHDES Drinking Water Source Protection Program and for the preparation and submittal of associated application materials to develop a River Management Plan for the Oyster River?

VIII. Committee Appointments

Shall the Town Council appoint Raymond Rodon, 18 Ross Road, and Renee Capicchioni Vannata, 5 Wood Road, to the Economic Development Committee?

IX. Presentation Items

A. Receive annual report of the Planning Board – Peter Wolfe, Chair
B. Update on NHDOT Project #13080, Route 108 bike lane/shoulder widening – NHDOT Project Manager Ronald Grandmaison
C. Presentation and discussion regarding water supply overview and priorities - Councilor Dave Howland
D. Presentation and discussion regarding the Spruce Hole Municipal Well and Artificial Recharge project –Town Engineer David Cedarholm, James Emery and John Brooks, Emery & Garrett Groundwater, Inc.

X. Unfinished Business

XI. New Business

XII. Nonpublic Session (if required)

XIII. Extended Councilor and Town Administrator Roundtable (if required)

XIV. Adjourn *(NLT 10:30 PM)*

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AGENDA ITEM: # 7A

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Todd I. Selig, Administrator

AGENDA ITEM: **SHALL THE TOWN COUNCIL SCHEDULE A PUBLIC HEARING FOR MONDAY, OCTOBER 15, 2012 ON A RESOLUTION AMENDING RESOLUTION #2012-11 TO: 1) CHANGE THE $745,000 FUNDING DESIGNATION WITHIN THE 2012 CAPITAL FUND BUDGET TO COME FROM SHORT-TERM BORROWING RATHER THAN THE UNDESIGNATED (UNASSIGNED) FUND BALANCE; AND 2) AUTHORIZING THE SHORT-TERM BORROWING OF SAID $745,000 FOR UP TO ONE YEAR TO PURCHASE THE PEOPLE'S UNITED BANK BUILDING LOCATED AT 8 NEWMARKET ROAD FOR USE AS THE FUTURE TOWN HALL?**

CC PREPARED BY: Jennie Berry, Administrative Assistant

PRESENTED BY: Todd I. Selig, Administrator

AGENDA DESCRIPTION:

On May 21, 2012 the Town Council held a public hearing on both the possible acquisition of the People's United Bank building located at 8 Newmarket Road and on Resolution #2012-11 to raise, appropriate, and expend an additional $745,000 within the 2012 Capital Fund Budget (with funds to come from the Undesignated Fund Balance) to purchase the 8 Newmarket Road site for use as the future Town Hall. The Council also adopted the resolution by a two-thirds majority vote required by Section 5.5 of the Durham Town Charter.

Since the adoption of Resolution 2012-11, Town staff has spoken with Moody's Investors Service who advises that it would be best to obtain funding for the $745,000 through short-term borrowing in order for the Town to retain its Undesignated (Unassigned) Fund Balance reserve amount should the economy worsen and cause a substantial decrease in property tax payments that could adversely affect the Town's bond rating. Durham's current Moody rating is Aa2 which means that the Town obligor has a very strong capacity to meet its financial commitments. It differs from the highest rated obligors only in small degree.

Section 5.5 of the Durham Town Charter states that no appropriation shall be made for any purpose not included in the annual budget as adopted unless approved by a two-thirds majority of the Council after a public hearing. The Council shall, by resolution, designate the source of any money so appropriated.

Section 5.12 of the Durham Town Charter enables the Town Council to approve the issuance of bonds or notes for less than $1,000,000 after holding a duly advertised public hearing, and further stipulates that for the purposes of borrowing, the Town of Durham shall have all the powers and duties vested with a city.

New Hampshire Revised Statutes Annotated (RSA) 33:9 authorizes the issuance of bonds by a city, by resolution of the Council, passed by at least two-thirds of all Council members.

Attached for the Council's information and consideration is a resolution that will amend Resolution 2012-11 to change the $745,000 funding designation within the 2012 Capital Fund Budget to come from short-term borrowing for up to one year instead of the Undesignated (Unassigned) Fund Budget. The resolution will also authorize the borrowing of these funds in accordance with Sections 5.5 and 5.12 of the Durham Town Charter and RSA 33:9 for the purchase of the former People's Bank building at 8 Newmarket Road for use as the future Town Hall.

LEGAL AUTHORITY:
New Hampshire Revised Statutes Annotated (RSA) 33:9
Sections 5.5 and 5.12 of the Durham Town Charter

LEGAL OPINION:
N/A

FINANCIAL DETAILS:
N/A

SUGGESTED ACTION OR RECOMMENDATIONS:

MOTION:
The Durham Town Council does hereby schedule a public hearing for Monday, October 15, 2012 on a resolution amending Resolution #2012-11 to:

1. ***Change the $745,000 funding designation within the 2012 Capital Fund Budget to come from short-term borrowing rather than the Undesignated (Unassigned) Fund Balance; and***
2. ***Authorizing the short-term borrowing of said $745,000 for up to one year to purchase the People's United Bank building located at 8 Newmarket Road for use as the future Town Hall.***

RESOLUTION #2012-XX OF DURHAM, NEW HAMPSHIRE

AMENDING RESOLUTION #2012-11 TO CHANGE THE $745,000 FUND DESIGNATION WITHIN THE 2012 CAPITAL FUND BUDGET TO COME FROM SHORT-TERM BONDING RATHER THAN THE UNDESIGNATED (UNASSIGNED) FUND BALANCE AND AUTHORIZING THE SHORT-TERM BORROWING OF SAID $745,000 FOR UP TO ONE YEAR TO PURCHASE THE PEOPLE'S UNITED BANK BUILDING LOCATED AT 8 NEWMARKET ROAD FOR USE AS THE FUTURE TOWN HALL

WHEREAS, on May 21, 2012 the Town Council held a public hearing on both the possible acquisition of the People's United Bank building located at 8 Newmarket Road and on Resolution #2012-11 to raise, appropriate, and expend an additional $745,000 within the 2012 Capital Fund Budget (with funds to come from the Undesignated Fund Balance) to purchase the 8 Newmarket Road site for use as the future Town Hall; and

WHEREAS, On May 21, 2012 the Town Council approved, by a two-thirds majority vote, Resolution #2012-11 to raise, appropriate, and expend an additional $745,000 within the 2012 Capital Fund Budget (with funds to come from the Undesignated Fund Balance) to purchase the People's United Bank building located at 8 Newmarket Road for use as the future Town Hall; and

WHEREAS, since the adoption of Resolution 2012-11, Town staff has spoken with Moody's Investors Service who advises that it would be best to obtain funding for the $745,000 through short-term borrowing in order for the Town to retain its Undesignated (Unassigned) Fund Balance reserve amount should the economy worsen and cause a substantial decrease in property tax payments that could adversely affect the Town's bond rating; and

WHEREAS, the Town desires to follow Moody's advice to finance the $745,000 through short-term borrowing; and

WHEREAS, Section 5.5 of the Durham Town Charter states that: "No appropriation shall be made for any purpose not included in the annual budget as adopted unless approved by a two-thirds majority of the Council after a public hearing. The Council shall, by resolution, designate the source of any money so appropriated. This provision shall not apply, however, to emergency appropriations adopted pursuant to 3.10 of this Charter"; and

WHEREAS, Section 5.12 of the Durham Town Charter enables the Town Council to approve the issuance of bonds or notes for less than $1,000,000 after holding a duly advertised public hearing, and further stipulates that for the purposes of borrowing, the Town of Durham shall have all the powers and duties vested with a city; and

WHEREAS, NH RSA 33:9 authorizes the issuance of bonds by a city, by resolution of the Council, passed by at least two-thirds of all Council members; and

WHEREAS, a duly noticed public hearing was held by the Durham Town Council on Monday, October 15, 2012 on the short-term borrowing issue;

NOW, THEREFORE BE IT RESOLVED that the Durham Town Council, the governing body of the Town of Durham, New Hampshire, does hereby approve Resolution #2012-XX amending Resolution #2012-11 to change the $745,000 funding designation within the 2012 Capital Fund Budget to come from short-term borrowing rather than the Undesignated (Unassigned) Fund Balance to purchase the People's United Bank building located at 8 Newmarket Road for use as the future Town Hall.

BE IT FURTHER RESOLVED that the Durham Town Council, the governing body of the Town of Durham, New Hampshire, does hereby authorize the short-term borrowing of $745,000 for up to one year for the purpose of purchasing the People's United Bank building located at 8 Newmarket Road for use as the future Town Hall.

PASSED AND ADOPTED this ____ day of _____by a two-thirds majority vote of the Durham Town Council with _____ voting in favor, _____ voting against, and _____ abstaining.

_____
Jay B. Gooze, Chair
Durham Town Council

ATTEST:

_____
Lorrie Pitt, Town Clerk

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AGENDA ITEM: #7B

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Plodzik & Sanderson, Town Auditors
Gail Jablonski, Business

AGENDA ITEM: **SHALL THE TOWN COUNCIL, UPON RECOMMENDATION OF AUDITORS PLODZIK & SANDERSON AND THE ADMINISTRATOR, ADOPT THE TOWN'S REVISED GENERAL FUND-FUND BALANCE POLICY?**

CC PREPARED BY: Gail Jablonski, Business Manager

CC PRESENTED BY: Todd I. Selig, Administrator

AGENDA DESCRIPTION:
The adoption of financial policies is a good, sound business practice that fosters confidence in the fiscal operations of the municipality. Financial policies help to provide consistency, stability and continuity in the financial operations of the Town. Written policies also provide a framework to guide and education both newly elected officials in carrying out their fiduciary responsibilities and newly appointed staff in the conduct of their financial duties. The ability to rely on well-defined financial policies helps to resolve conflicts and avoid allegations of bias or favoritism.

In February 2009, Governmental Accounting Standards Board (GASB) issued Statement No. 54, *Fund Balance Reporting and Governmental Fund Type Definitions*, which is required to be implemented for the first fiscal year ending June 30, 2011. The objective of GASB 54 is to enhance the usefulness of fund balance information by 1) clarifying existing governmental fund type definitions, and 2) providing clearer fund balance classifications that can be more consistently applied.

The recent audit presentation by Greg Colby, Plodzik & Sanderson outlined the new categories and terminology being used. This revised policy outlines the new classifications – Nonspendable, Restricted, Committed, Assigned and Unassigned. In addition, DRA, which previously recommended an Unassigned Fund Balance of

5%-8%, now recommends that communities follow the guidelines provided by the Governmental Finance Officers Association relative to the amount of Unassigned Fund Balance maintained by a community which is between 8%-17% of the general fund's annual budget, including Town, School and County appropriations. The Town Administrator and Business Manager are recommending we maintain an unassigned fund balance of 5%-8% which is what DRA previously recommended.

The total of the Town of Durham appropriations for 2011 were as follows:

Town	$11,277,208
School - Local	$14,089,125
School – State	$ 2,062,013
County	$ 2,344,608
Total	$29,772,954
5% - 8%	$ 1,488,648 - $ 2,381,840
8% - 17%	$ 2,381,840 - $ 5,061,402

In 2011 the Town's Unassigned Fund Balance was $992,950 or 3.3% of the total appropriations.

Although the statutes do not specifically address fund balance policies, the Town Administrator and this office believe it is prudent to establish and maintain appropriate internal control procedures to ensure the safeguarding of all town assets and properties.

LEGAL AUTHORITY:
N/A

LEGAL OPINION:
N/A

FINANCIAL DETAILS:
None

SUGGESTED ACTION OR RECOMMENDATIONS:

MOTION
The Durham Town Council does hereby adopt, upon the recommendation of auditors Plodzik & Sanderson and the Administrator, the Town's revised General Fund-Fund Balance Policy.

TOWN OF DURHAM, NH
GENERAL FUND - FUND BALANCE POLICY

I. PURPOSE AND SCOPE

The general purpose of this policy is to ensure the Town of Durham's financial stability by protecting itself against emergencies and economic downturns. This policy is also designed to help the Town prepare for a financial emergency as well as contribute to the continuity of financial operations. This policy encompasses the minimum required fund balance reserves, as well as the allowable uses of fund balance reserves.

This policy is written in accordance with the Governmental Accounting Standards Board (GASB) Statement No. 54, *Fund Balance Reporting and Governmental Fund Type Definitions*, effective for periods ended June 30, 2011 and later.

II. DEFINITIONS

Fund Balance: The accumulated equity balance in a governmental fund resulting from operations over the years. This is the difference between fund assets and fund liabilities. Total Fund Balance is classified into the following categories:

Nonspendable Fund Balance – permanent trust funds (nonexpendable portion) and non-cash assets such as inventories or prepaid items.

Restricted Fund Balance – funds legally restricted for specific purposes, such as grants, public library, income balance of permanent funds, and capital project funds which cannot change purpose.

Committed Fund Balance – amounts that can only be used for specific purposes pursuant to a formal vote by the Town Council; such as expendable trust (capital reserve), nonlapsing appropriations, and other special revenue funds not listed under restricted which can change purpose via vote by the Town Council in accordance with the provisions of the New Hampshire Revised Statutes Annotated (RSAs).

Assigned Fund Balance – amounts intended by the Town Council for specific purposes. All appropriations shall lapse at the end of the fiscal year unless authorized in accordance with the provision of RSA 32:7. The Council can choose to delegate to the Town Administrator or Business Manager, depending on the situation. Items that would fall under this type of fund balance could be encumbrances.

Unassigned Fund Balance – residual spendable fund balance after subtracting all of the above amounts.

General Fund: A fund used to account for basic governmental services supported mainly by tax revenue. Accounts for all financial resources not required to be accounted for in another fund.

Overexpenditure: In emergency situations which may cause an overexpenditure of total appropriations, the Town will follow the provisions of the State Municipal Budget Law (RSA 32:11).

Spending Prioritizations: When an expenditure is incurred that qualifies for payment from either of the three unrestricted fund balance categories, it will be applied in the following order:

1) Committed; 2) Assigned; 3) Unassigned

III. FUND BALANCE RESERVES - GENERAL FUND

Fund Balances recommended by the NH Department of Revenue Administration (DRA) and the Government Finance Officers Association (GFOA) are as follows:

If All Appropriations and Tax Commitments Total:	Unassigned Fund Balance Recommended:	
	8%	17%
$25,000,000	$2,000,000	$4,250,000
$30,000,000	$2,400,000	$5,100,000
$35,000,000	$2,800,000	$5,950,000
$40,000,000	$3,200,000	$6,800,000
$45,000,000	$3,600,000	$7,650,000
$50,000,000	$4,000,000	$8,500,000

Minimum Target Balance: The Town shall work toward maintaining an unassigned fund balance of at least 5% to 8% of the general fund's annual budget, including Town, School and County appropriations.

Plan for Target Balances: The unassigned fund balance target level shall be achieved by conservatively estimating revenues and using only minimal amounts to reduce the tax rate when necessary. Furthermore, attaining the target fund balance level of 8% may also be achieved by adding a line item to the annual budget for the sole purpose of building unassigned fund balance, if it is determined appropriate to do so.

Fund Balance Uses: Unassigned fund balance may be used to offset property taxes as part of the final adopted budget for a fiscal year keeping in consideration the Town's desire to maintain a targeted unassigned fund balance level of 5% to 8%. For emergency purposes, or other uses as deemed necessary, the Council may appropriate unassigned fund balances even if such use decreases the unassigned fund balance below the designated percentage.

Adopted by Durham Town Council _____

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AGENDA ITEM: # 7C

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Strafford Regional Planning Commission

AGENDA ITEM: **SHALL THE TOWN COUNCIL ENDORSE A LETTER OF SUPPORT FOR THE STRAFFORD REGIONAL PLANNING COMMISSION (SRPC) TO APPLY FOR LOCAL SOURCE WATER PROTECTION GRANTS THROUGH THE NHDES DRINKING WATER SOURCE PROTECTION PROGRAM AND FOR THE PREPARATION AND SUBMITTAL OF ASSOCIATED APPLICATION MATERIALS TO DEVELOP A RIVER MANAGEMENT PLAN FOR THE OYSTER RIVER?**

CC PREPARED BY: Jennie Berry, Administrative Assistant

PRESENTED BY: Todd I. Selig, Administrator

AGENDA DESCRIPTION:

In 2011, legislation was enacted by the State Legislature to designate segments of the Oyster River as a protected river under New Hampshire Revised Statutes Annotated (RSA) 483, New Hampshire Rivers Management and Protection Program (RMPP). When the designation became effective on June 2, 2011, the Oyster River joined a select group of rivers already designated under the RMPP. Designation calls for protection and management of New Hampshire's outstanding rivers through a two-tiered approach: state protection of instream values, and local management of riparian lands. The RMPP is administered by the Department of Environmental Services (DES) under RSA 483.

In October 2011, the Town of Durham nominated four individuals for appointment by the DES Commissioner to the newly-formed Oyster River Local Advisory Committee (ORLAC).

The Strafford Regional Planning Commission (SRPC) proposes to work with the ORLAC and other municipal stakeholders to assist in the development of a River Management Plan. The River Management Plan will identify short-term, intermediate, and long-term goals for the river and watershed protection along with

strategies to address them. An Action Plan will organize the goals and strategies in a timeframe that allows for effective and timely implementation.

During the development of the Plan, ORLAC and Strafford Regional Planning Commission will engage public participation, work to improve the protection and management of the river, and complete ongoing efforts at the local level that are needed to address the use and conservation of the river corridor and watershed; tasks include:

- Collecting input through a river corridor survey sent to property owners and elected officials;
- Interviews with Conservation Commissions in the Towns of Barrington, Lee, Madbury, and Durham;
- Key person interviews with representatives from local government and agencies and nonprofit groups active in the watershed; and
- Public informational meetings for review and comment on the draft and final river management plans

The SRPC believes there is a unique opportunity for both the regional planning commission and the local advisory committee to work with the Town of Durham and their two consulting firms to work together, as Durham is already focusing on a watershed-wide management plan. Being able to share resources and working together will not only strengthen the grant application but will serve to create a more comprehensive corridor management plan for the river and its resources.

The SRPC is in the process of applying for Local Source Water Protection Grants through the NHDES Drinking Water Source Protection Program. Those eligible to apply include: water suppliers, municipalities, regional planning commissions, non-profit organizations, county conservation districts, watershed associations, state agencies, and education institutions. Since 1997, NHDES has made small grants available to these entities for the purpose of protecting drinking water sources. The purpose of the funding is to provide expertise and assistance during the development and adoption of a local river corridor management plan pursuant to RSA 483:10; thus fulfilling the local advisory committee's legal responsibility for creating a management plan for the Oyster River as it pertains to the NH Rivers Management and Protection Program. To date, the SRPC has received letters of support from the Towns of Barrington and Lee. A copy of the letter Administrator Selig would send upon endorsement by the Town Council is attached.

More information regarding the application process can be viewed on the Source Water Protection Grant website through NHDES at:
http://des.nh.gov/organization/divisions/water/dwgb/dwspp/lswp_grants.htm

LEGAL AUTHORITY:
New Hampshire Revised Statutes Annotated (RSA) 483, New Hampshire Rivers Management and Protection Program (RMPP).

LEGAL OPINION:
N/A

FINANCIAL DETAILS:
N/A

SUGGESTED ACTION OR RECOMMENDATIONS:
Take action concerning the Town's interest in SRPC moving forward with applying for grant funds to develop a River Management Plan for the Oyster River and submitting a letter of support for this effort. After discussion consider making the following motion:

MOTION:
The Durham Town Council does hereby endorse the draft Letter of Support for the Strafford Regional Planning Commission to apply for Local Source Water Protection Grants through the NHDES Drinking Water Source Protection Program and in the preparation and submittal of associated application materials to initiate a River Management Plan for the Oyster River.

October 2, 2012

Ms. Johnna McKenna
NHDES Drinking Water and Groundwater Bureau
29 Hazen Drive
Concord, NH 03302-0095

Dear Ms. McKenna:

On October 1, 2012, the Durham Town Council voted to support the efforts of the Oyster River Local Advisory Committee (ORLAC) to complete a Corridor Management Plan for the Oyster River, with the assistance from the Strafford Regional Planning Commission, and endorses the Regional Planning Commission's application for funding through the New Hampshire Department of Environmental Services, Drinking Water Source Protection Program. The purpose of this funding is to provide expertise and assistance during the development and adoption of a local river corridor management plan pursuant to RSA 483:10; thus fulfilling the local advisory committee's legal responsibility for creating a management plan for the Oyster River as it pertains to the New Hampshire Rivers Management and Protection Program.

The Oyster River is a vital natural resource for the Town of Durham, as well as other communities in the watershed. It serves as a municipal drinking source for Durham and the University of New Hampshire and supports vital functional value for wildlife and aquatic species. The Town of Durham recognizes the importance of protecting riparian lands along the Oyster River, yet threats to the integrity of the river remain and can be dealt with effectively though a coordinated system of planning and management.

The Town of Durham understands the importance of developing a comprehensive management plan, which will include future goals and objectives in the protection of the river and its watershed for years to come. The Town of Durham is also committed in making a good-faith effort to implement recommended source water protection measures, when appropriate, as an outcome of this project.

Yours truly,

Todd I. Selig
Administrator

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AGENDA ITEM: # 8

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Raymond Rodon, 18 Ross Road
Renee Capicchioni Vannata, 5 Wood Road

AGENDA ITEM: **SHALL THE TOWN COUNCIL APPOINT RAYMOND RODON, 18 ROSS ROAD, AND RENEE CAPICCHIONI VANNATA, 5 WOOD ROAD, TO THE ECONOMIC DEVELOPMENT COMMITTEE?**

CC PREPARED BY: Jennie Berry, Administrative Assistant

PRESENTED BY: Todd Selig, Administrator

AGENDA DESCRIPTION:
There are currently two vacancies on the Economic Development Committee (EDC) created by the resignations of regular member Tom Elliott (term expiration of April 2015) and alternate member Doug Clark (term expiration of April 2013). Their resignation notices are attached for the Council's information.

Attached for the Council's review are two completed applications for board appointments submitted by Renee Capicchioni Vannata and Raymond Rodon. Mr. Rodon had originally expressed his desire to serve on one or all of the three boards/committees listed on his application and attended the Council meeting on August 20, 2012. After the Council holding a discussion with Mr. Rodon, it was suggested that he give further consideration as to where his particular interests and talents might be utilized that could best serve the Town. Since that meeting Mr. Rodon has been in contact with EDC Chair Ute Luxem. Ms. Luxem and Mr. Rodon agree that he would be a very good fit for the EDC, and Ms. Luxem recommends that the Town Council appoint Mr. Rodon to fill the regular member vacancy created by Tom Elliott.

Ms. Luxem also recommends that Ms. Vannata be appointed to fill the alternate member vacancy created by Doug Clark. She indicates in her correspondence (attached) that Ms. Vannata applied to the EDC after attending a recent workshop

held by the committee. She notes that Ms. Vannata has served as a library trustee, is well-connected within the community, and would be a valuable asset to the committee. Ms. Vannata has been invited to attend Monday night's meeting for introduction to the Council if she so desires.

LEGAL AUTHORITY:

Durham Town Charter, Section 11.5 "Vacancies in Elected or Appointed Office" states:

> *Unless otherwise specified in this Charter, in the event of a vacancy in an elected or appointed office, board, commission or committee of the town, the Town Council shall fill that vacancy by appointment, such appointment to continue until the next town election for elected positions or the remainder of a person's term if an appointed position."*

LEGAL OPINION:

N/A

FINANCIAL DETAILS:

N/A

SUGGESTED ACTION OR RECOMMENDATIONS:

MOTION 1:

The Durham Town Council does hereby APPOINT Raymond Rodon, 18 Ross Road, to fill the regular member vacancy of Tom Elliott on the Economic Development Committee with a term expiration of April 30, 2015.

MOTION 2:

The Durham Town Council does hereby APPOINT Renee Capicchioni Vannata, 5 Wood Road, to fill the alternate member vacancy of Doug Clark on the Economic Development Committee with a term expiration of April 30, 2013.

Jen Berry

Subject: FW: Your Interest in Serving on a Town Board, Commission, or Committee

Jay,

Doug Clark and Tom Eliott resigned from the EDC yesterday and today. I interviewed with Ray before he left to Afghanistan, and we agreed that he would be a very good fit for the EDC. I would like to recommend to the Council the appointment of Jay Rodon to the permanent position vacated by Tom. Ray has extensive business knowledge and experience, and brings a balanced view to the EDC. He will be a valuable resource and asset.

Renee Capicchioni Vannata applied to the EDC yesterday after coming to our workshop Monday. Renee has served as a library trustee and is well connected within the community. She enthusiastically cares for our community, especially the downtown area. She will be a valuable asset, and I would like to recommend her appointment to the alternate position vacated by Doug Clark.

Would you like me to come to the next council meeting to introduce Renee? You already spoke with Ray, correct?

Sincerely yours,

Ute

From: Jay Gooze [mailto:jgoozetc@gmail.com]
Sent: Wednesday, September 26, 2012 9:11 PM
To: Raymond Rodon
Cc: Jen Berry; Ute Luxem
Subject: Re: Your Interest in Serving on a Town Board, Commission, or Committee

Ray, check with Ute and be sure someone is leaving the Committee as there is no vacancy at this time. Jay

On Sep 26, 2012, at 6:23 PM, Raymond Rodon <raymond.rodon@gmail.com> wrote:

> Jeanie,
>
> Thanks for the note and sorry it has taken so long to get back to you. I am just returning from Afghanistan and it was quite the exciting time.....
>
> I've decided that I would like to be on the economic committee with Ute, copied here.
>
> Thanks for all your assistance.
>
> Ray
>
> On Thu, Sep 6, 2012 at 10:24 AM, Jen Berry <jberry@ci.durham.nh.us> wrote:
>
> Hello Mr. Rodon,

I understand that you were going to look into other Town boards/committees to see where your interest might lay. I'm not sure if you have had an opportunity to do this yet, but I thought I might update you on the current vacancies that exist on the various Town boards, commissions, and committees. Once you have made a decision, you may simply let me know what you have decided and I will place it on a future Council agenda for review and action. There is no need for you to attend another Council meeting as the Council has already met with you. Also, if you would like the contact information of any Chairperson so that you might speak with them and gain more information on a particular board, please let me know and I will be glad to provide you with that information.

That all said, here are our current vacancies:

Conservation Commission, 1 alternate member vacancy. Meets the second Thursday of each month.
Historic District Commission, 1 vacancy. Meets the first Thursday of each month.
Parks & Recreation Committee, 1 regular member and 1 alternate member vacancy. Meets the fourth Thursday each month.
Planning Board, 2 alternate member vacancies. Meets the second and fourth Wednesday of the month.
Rental Housing Commission, 1 neighborhood representative. Usually meets once a month, but are not on a particular schedule,
Zoning Board of Adjustment, 1 regular member vacancy. Meets the second Tuesday of each month.
Durham Energy Committee, 1 vacancy. Usually meets once a month, but are not on a particular schedule
Integrated Waste Management Advisory Committee, 1 regular member and 1 alternate member vacancy. Meets the third Thursday of each month.

I hope this helps. As I say, let me know if you would like contact information for any of the Chairpersons of these meetings. Otherwise, I will wait to hear from you as to what your interests may be in serving on any of these committees.

Jennie-

Jennie Berry

Jennie Berry
Administrative Assistant
15 Newmarket Road
Durham, NH 03824
603-868-5571

Town of Durham

15 Newmarket Road
Durham, NH 03824-2898
Tel: 603/868-5571
Fax 603/868-5572

Application for Board Appointment

Type of Appointment and Position Desired (Please select only one):

New appointment/regular member ☒ New appointment/alternate member ☒
Reappointment/regular member ☐ Reappointment/alternate member ☐

Name: RAYMOND L. RODON Date: 31 July 2012

Address: 18 ROSS Rd, DURHAM N.H. 03824

E-Mail Address: RAYMOND.RODON@gmail.com

Home Telephone: 603-312-2043 / Cell 202-617-6829 Best #

Board/Commission/Committee you are interested in being appointed to. (Please list in order of preference, if interested in more than one appointment).

1. LAMPREY RIVER ADVISORY
2. HISTORIC DISTRICT
3. Planning Board

Please provide a brief explanation for your interest in appointment to a particular board, commission or committee: I would be willing to serve on several boards, the ones selected all appeal to me in terms of conservation and history. Having served in the military & have a planning background and have participated in the planning of base infrastructure projects. I am a member of the National Wildlife Federation and NH. Audubon Society and so have a great interest in the Outdoors. I am also a history buff so preserving our history is important

Please provide brief background information about yourself: Retired U.S Army Colonel having served over 28 years - served in two (as military & civilian) Logistics (supply, transport, maintenance) background, currently working for a contractor supporting U.S. military primarily in Afghanistan. Married, 5 children - all grown and recently moved to Durham. Very interested in the community and providing community service.

Please provide below the names and telephone numbers of up to three personal references:

Name: JACK VANCE Telephone: 571-232-0717
Name: LUCY DUNCAN Telephone: 202-270-5978
Name: JEAN FEEGEL Telephone: 603-781-5559

♦♦♦♦♦♦♦♦♦♦♦♦

Thank you for your interest in serving the Town. Please return this application, along with a resume, if available, to: Town Administrator, 15 Newmarket Road, Durham, NH 03824.

Raymond L. Rodon, Col, USA (R)

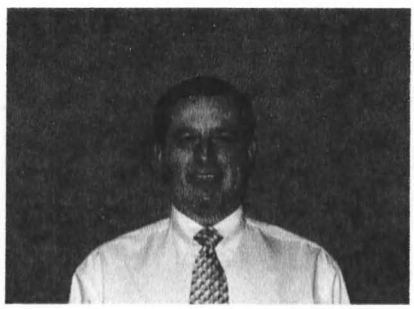
Raymond Rodon is the Executive Vice President of Operations at Safe Ports Inc; a woman owned small business headquartered in Charleston, SC. As the EVP for Operations, Ray is responsible to the CEO for execution of all work whether US Government contract or commercial. His current primary focus is executing the Defense Distribution Depot in Kandahar, Afghanistan.

Ray's extensive government and commercial logistics experience come from a career in both the U.S. Military and the defense contracting community. Ray's positions within the U.S. Department of Defense (DoD) include Battalion Commander of the 260th Quartermaster Battalion which served with distinction during the 1st Gulf War supporting the 24th Infantry Division (Mechanized); Brigade Commander of the 23rd Quartermaster Brigade at Fort Lee, VA; Director of DoD Disposal Policy for the Defense Logistics Agency, and Deputy Director for the Defense Energy Support Center at Fort Belvoir, Virginia.

Ray moved into the industrial sector in 2000 as a Senior Director at Enron-Enron Energy Services where he ran the Facilities Maintenance Program. He then spent six years working for Kellogg Brown & Root Services, Inc (KBR), primarily as the Deputy Program Manager for the LOGCAP III Project. Ray's most recent position with KBR was Senior Operations Director for KBR Government Services and Business Development Director.

Prior to coming over to Safe Ports, Ray served as the Vice President of Business Development for the Europe, Middle East and Africa (EMEA) business unit of Agility Defense & Government Services (DGS). Agility DGS is one of the world's leading providers of integrated logistics to governments, relief agencies, and international institutions. Ray was responsible for all activities associated with business development for Agility DGS in Europe, the Middle East, and Africa including capture management of new business, re-winning current work; customer relations and International Relations.

Ray graduated from Kent State University with a degree in Botany and received a master's degree in Administration from Central Michigan University. He is married to Martha S. Caswell and together they have five children ranging in ages from 35 to 23 years old. He currently resides and works in Alexandria, VA.



RAYMOND L. RODON

18 Ross Rd, Durham NH 03824

raymond.rodon@gmail.com
Phone: (603) 312-2043

Senior Project Management / Logistics Management / Operations / Business Development

Objective is to serve in the senior levels of management where I can best make a contribution to the company's bottom line. I am a results oriented professional with over 30 years leading senior level projects. Experienced in both strategic and tactical planning for contingencies or deliberate operations; skilled builder of high performance teams resulting in completion of highly successful projects. Highly knowledgeable and skilled in the art of project management, human resources management, financial management, security and operations.

CAREER ACCOMPLISHMENTS

05/2010 – Present **SAFE PORTS, INC** **Arlington, Virginia**

EXECUTIVE VICE PRESIDENT, FIELD OPERATIONS AND STRATEGY. Safe Ports is a woman owned small business headquartered in Charleston, SC. The core competencies of the company include security, supply chain logistics, and human capital management. Responsibilities include execution of on-going contracts to include Profit-Loss and contract administration. Coordinate the human resources management, Finance-Accounting, Quality management, Environmental, Health and Safety Management, and Logistics. Developing and executing process and procedures for operations. Assisting the EVP for Government Solutions in the pursuit and capture of primarily Department of Defense opportunities.

- Safe Ports won the 5 year, $40M contract in October 2010 to operate the DLA Distribution GOCO Depot in Kandahar, Afghanistan; DLA Distribution's first Depot in a war zone.
- Though work load has steadily increased continued to meet all Approved Performance Levels.
- Bid and won contract line items supplying bulk fuel to US Forces in Colombia

01/2009 – 4/2010 **AGILITY- DEFENSE & GOVERNMENT SERVICES** **Kuwait City, Kuwait**

VICE PRESIDENT, Business Development for Europe, Middle East and Africa. Promoted to Vice President and relocated to Kuwait. Responsible for all activities associated with business development for the four P&L's which make up the Europe, the Middle East and Africa regions of Defense and Government Services business unit. Develop, implement and maintain policies, procedures and process to effectively and efficiently assist in the building and maintenance of the opportunity pipeline. Prepare analyses, White Papers and other documents that assist in the creation and capture of new opportunities. Responsible for the maintenance of strategic partnerships and relationships; execute Teaming Agreements and NDA's. Supervise the Kuwait Proposal Center staff of 8 personnel in the capture of new work through the submission of qualified technical and cost proposals; and supervised 2 BD Directors and 8 BD Managers and 2 BD Analysts. The Kuwait Business unit was eliminated in 2010.

- Oversaw the winning of over $300M annualized value of new work
- Established a qualified pipeline that was four times the 2010 revenue goal for each P&L.
- Established standardized policies and procedures for the capture of new work

02/2008 – 12/2008 **AGILITY- DEFENSE & GOVERNMENT SERVICES, INC** **Alexandria, VA**

EXECUTIVE DIRECTOR - OPERATIONS. Manages and directs daily operations of the Americas & Asia Pacific Business Unit. Responsibilities include oversight of Program Managers, Business Manager, Small Business Director, Project Management Office and Supply Chain Management Center. Manages all internal resources and allocates resources to successfully execute projects. Performs duties in the absence of the VP, Americas and Asia Business Unit. Met or exceeded all goals and Key Performance Indicators for the product line

06/2006 – 2/2008 **KELLOG BROWN & ROOT SERVICES, INC** **Arlington VA**

DIRECTOR OF LOGISTICS - Responsible for the day to day operations of the company's logistical support projects in Kuwait and Iraq which included setting-up and operating camps, bulk fuel operations and transportation support. I served as a Capture Manager to lead the process of developing concept of operation, staffing, budget and working with the proposal team to write a competitive and compliant proposal. Upon winning of new work, serve as Transition Manager for project start-up coordinating with KBR functional staff to insure project met start-up and operations goals.

- Projects met or exceeded all Health, Safety and Environmental goals.
- All projects came in under budget and exceeded client expectations
- Won and transitioned the Bulk Fuel Contract supporting US Forces in Kuwait and Iraq.

RAYMOND L. RODON

18 Ross Rd, Durham NH 03824

raymond.rodon@gmail.com
Phone: (603) 312-2043

2/2005-05/2006 **KELLOG BROWN & ROOT SERVICES, INC** **Kuwait City, Kuwait**

DIRECTOR, BUSINESS DEVELOPMENT - Responsible for the addition of profitable new work for the company with emphasis on US Government contracts. Work is accomplished through the identification of opportunities to provide services to new and existing clients; ensuring opportunities are brought to contractual/financial closure; providing a link between customers and KBR operations; recognizing and reacting to market changes that require strategic direction; helping to maintain customer loyalty; exhibiting a professional image and brand of KBR to the market place. Lead the team in marketing, proposal development; financial analysis, risk/insurance issues, operations and execution of the services.

- Successfully bid and won five new projects valued at over $150 million in Kuwait and Iraq
- Developed customer contacts and built relationships based on execution performance
- Profit and Loss responsibility for the projects

01/2002-1/2005 **KELLOG BROWN & ROOT SERVICES, INC** **Houston, Texas/ Baghdad, Iraq**

DEPUTY PROGRAM GENERAL MANAGER – Overall responsible for the day to day operations and management of the 80 Task Orders in support of U.S. Military operations worldwide providing all logistics support (supplies, transportation-distribution, services) and temporary construction including base camps. Funding for the project grew to over $8 billion per year and included over 12,000 direct employees and 25,000 subcontractor personnel. Responsibilities included planning, staffing, risk management and budgeting of all task orders with direct emphasis on operations.

- Project Start-Up - deployed to Djibouti, Kuwait, Turkey and Iraq to start projects in support of U.S. Army. Established operations; initiated business systems; entered into service, supply and labor contracts; exceeded all support and timeline requirements.
- Performed contract management responsibilities with the Procurement Contracting Officer her staff.
- Project Manager for Start-up of the Restore Iraqi Oil Project. Deployed across Kuwait border on day one of the war to extinguish oil well fires and initiate repair of Iraqi oil infrastructure.
- Provided unprecedented support to coalition forces in a war zone; No mission failures
- Project received "Excellent" award fee scores on majority of the task orders
- Profit and Loss responsibility for the project

2000-2001 **ENRON-ENRON ENERGY SERVICES** **Houston, Texas**

SENIOR DIRECTOR - Developed and implemented the initial business model for Facilities Management (FM) Program for Enron Energy Services (EES). Under this program, I was responsible for the execution of the Operations and Maintenance program of client owned facilities, energy equipment and/or their production equipment. Assisted in the business development of the Federal Privatization of Utilities Program and responsible for the operations and execution of the projects when awarded.

- Provided for the planning, staffing, budgeting, policies/procedures and creating operational concepts for the management of FM contracts - valued at over $100 million.
- Monitored performance of EES FM contracts to ensure deliverables were being executed per contract terms and conditions; past performance was the key to client up-sell and new contracts.

1972-2000, served in the United States Army in positions of increasing responsibility including staff and command assignments retiring at the rank of Colonel. Successfully commanded at the Company, Battalion and Brigade levels to include commanding a battalion in combat during the 1st Gulf War. Career assignment locations included the United States, Germany, Korea and Saudi Arabia-Iraq. Last active duty position was Deputy Director of the Defense Energy Support Center (now DLA Energy) from1998-2000.

EDUCATION & TRAINING INFORMATION

Education

- **Masters of Arts**, Administration, Central Michigan University
- **Bachelor of Science**, Botany, Kent State University.

Professional Development Training

- Industrial College of the Armed Forces (War College)
- United States Army Senior Management School
- United States Logistics Management College

Town of Durham
15 Newmarket Road
Durham, NH 03824-2898
Tel: 603/868-5571
Fax 603/868-5572

Application for Board Appointment

Type of Appointment and Position Desired (Please select only one):

New appointment/regular member ☑ New appointment/alternate member ☐
Reappointment/regular member ☐ Reappointment/alternate member ☐

Name: Renée Capicchioni Vannata Date: 9/25/2012

Address: 5 Wood Road Durham

E-Mail Address: safaritour@comcast.net

Home Telephone: (603) 868-5199 cell (603) 781-4074

Board/Commission/Committee you are interested in being appointed to. (Please list in order of preference, if interested in more than one appointment).

1. Economic Development Committee
2.
3.

Please provide a brief explanation for your interest in appointment to a particular board, commission or committee:

I would like to facilitate the stabilization of the residential tax burden through economic development and encourage diverse business and job creation in the town of Durham.

Please provide brief background information about yourself:

Small business owner, social media DIVA, former Durham Public Library trustee, natural-born "Connector", passionate about DURHAM.

Please provide below the names and telephone numbers of up to three personal references:

Name: Jenna Roberts Telephone: (603) 502-4405 cell
Name: Tom Elliot Telephone: (603) 995-1666 IGH
Name: Karen Larson Telephone: (603) 397-5154 The Candy Bar

♦♦♦♦♦♦♦♦♦♦♦♦

Thank you for your interest in serving the Town. Please return this application, along with a resume, if available, to: Town Administrator, 15 Newmarket Road, Durham, NH 03824.

Electronic Resume available on:
www.linkedin.com/in/reneevannata

Renée Capicchioni Vannata

5 Wood Road Durham, NH 03824 (603) 781-4074 safaritour@comcast.net

linkedin.com/in/reneevannata twitter.com/safaritour foursquare.com/safaritour
facebook.com/renee.vannata gplus.to/reneevannata klout.com/safaritour

Professional Summary

Extensive experience covering social media, marketing, international education, information technology, software development & implementation, process improvement and problem solving.

Experience

Portsmouth Team Building Durham, NH 2011-current
Co-Owner

- Creator of a small business start-up that offers unique high-tech fast paced indoor and outdoor team building adventures in downtown Portsmouth NH.
- Custom Facebook page management of http://www.facebook.com/PortsmouthTeamBuilding.
- Build alliances with small downtown retail businesses.
- Internet marketing, website promotion and SEO (Search Engine Optimization).
- Website creation, maintenance and analytics.
- Monitor social media world for opportunities, responses.
- Promote services through paper, electronic and human outlets.
- Research mobile technology strategies for future expansion.

Coyote Grill Restaurant Waterville Valley, NH 2011-current
Social Media Consultant

- Create and maintain a social media presence for an award winning resort dining experience.
- Facebook page management of http://www.facebook.com/CoyoteGrillNH.
- Monitor competitors, resort and regional social media for optimization of user's interests.
- Promote restaurant on online venues for awards and accolades.

Durham Public Library On The Move Durham, NH 2011-current
Social Media Consultant

- Integral member of committee for strategic public relations and marketing collateral copy and design.
- Shepherd community volunteer committee for advocacy events.
- Oversee community volunteer committee for media outreach.
- Created and manage a Video Contest which engages middle and high school students to produce video productions around the theme of "What my library means to me".
- Manage the Facebook feeds on http://www.facebook.com/DPLOnTheMove. Generate Facebook influence by creating advertisements and QR codes.
- Organize and maintain the YouTube Channel http://www.youtube.com/user/DPLOnTheMove.

University of New Hampshire Durham, NH 2001-2002,2003-2011
Information Coordinator – Office of International Students & Scholars (OISS)

- Provide vital technical, administrative and miscellaneous support for OISS, promoting international education by facilitating enrollment and employment of foreign nationals.

Technical

- Coordinate and assist in the data accuracy and integrity in Student and Exchange Visitor Information System (SEVIS) to maintain compliance with regulations for US Citizenship and Immigration Services and Department of State.
- Manage data regarding International Students and Scholars ensuring that all subsequent information systems are updated and consistent. Create and update records, verify changes, generate reports, and maintain accurate electronic and paper records.
- Serve as International Student and Scholar data steward (functional data expert) to ensure accurate data interfaces and DHS compliance with numerous UNH offices.
- Oversee and implement all lifecycle needs for OISS upgrades and problem resolutions from, requests for projects, functional specifications, testing, documentation, security oversight, and training key of users.
- Act as technical specialist for new desktop and software package deployments, numerous website and software upgrades.
- Coordinate project to secure software for process improvement & compliance.
- Identify, analyze, recommend and influence automation of business procedures and outdated technology processes while encouraging forward movement of technology to assist in the office's mission and vision.
- Compile statistical reports for both the International Student and the International Scholar populations at UNH Durham and UNH Manchester. Delivered numerous ad-hoc statistical, directory, and field-parsed reports on demand.

Administrative

- Assist with International Student and Scholar advising by disseminating information regarding maintenance of valid immigration status, immigration regulation changes, employment authorization, with intermediate knowledge of F1 and J1 visa regulations,. Screen and refer requests for information from phone, e-mail, and foot traffic.
- Essential part of cohesive team that provides superior customer service. Effectively manage workload by delegating, reprioritizing and verbalizing to team when help assistance is needed.

Student Advising & Programming

- Advise students on completion of applications for tax treaty benefits.
- Manage password distribution for CINTAX tax preparation software and provide basic tax advising.
- Assist in programming for several community events.

Miscellaneous

- Supervision of dozens of work-study students for administrative, technical and programming needs.
- Attended numerous training opportunities including NAFSA Region XI Spring Immigration Workshops, NAFSA Region X and XI conference, NAFSA NH State meetings, NAFSA Annual Conference, 2011 NH International Education Conference, NEBUG conference, NAFSA Webinars, CINTAX demonstration and webinar, SQL 1, SQL 2, Microsoft Access 2007, WebIntelligence training, Xtender training, Windstar Tax Navigator demonstrations, Adobe Professional training, and Dreamweaver training.

Office Assistant – Alumni Information Services 2003

- Data validation, data cleansing and data management of alumni biographical information in a Datatel Benefector system.
- Reorganization of data for corporations that are current or past employers of alumni.

Newmarket International Portsmouth, New Hampshire 2001
Marketing Specialist

- Essential contributor on the Marketing team for the leading vendor of Hotel Sales & Catering software. Supported various projects for the Company's webmaster, event planner, public relations and advertising managers.
- Management of vendor relationships from a logistics and a financial liaison standpoint.
- Statistical analysis of attendee evaluations from the company's annual user's conference.
- Assistance with the creation and production of collateral for tradeshows and sales efforts.
- A/R, A/P and budget reconciliation for all activities performed within the marketing department.

Liberty Mutual Insurance Portsmouth, New Hampshire 1995 to 1999
Software Engineer Project Leader

- Championed the effort to improve processes in order to achieve the Quality Assurance software industry standard of Capability Maturity Model (CMM) Level 2 in the key process area of Software Configuration Management.
- Established defined and repeatable processes for Subcontract Management, Defect and Issue Management, and Application Inventory tracking for the Commercial Markets platform conversion efforts.
- Designed and implemented a software measurement process to measure the schedule, scope, and budget performance of software development projects in Commercial Markets I/S.
- Provided leadership, support, and direction for the Property and General Liability Policy Publishing Project. Served as the test manager for alpha and beta releases of the software product.

Chubb LifeAmerica Concord, New Hampshire 1994 to 1995
Senior Programmer/Analyst

- Led several projects to enhance existing Group Insurance Underwriting and Policy Administration systems.
- Implemented multiple applications utilizing a package form generating software.

Keane Incorporated Bedford, New Hampshire 1989 to 1994
Programmer/Analyst

- Developed and maintained the Workers' Compensation Claims system, Property and Casualty Claims system and Workers' Compensation premium system at **Liberty Mutual**.
- Consulted at **New Hampshire Insurance**. Programmed to automate the 1099 Tax Filing System. Modified the Policy Maintenance System. Developed the Loss Reporting System.

Education

- Master of Business Administration (MBA). New Hampshire College Graduate School of Business (http://www.snhu.edu/), Manchester, NH.
- Bachelor of Science in Applied Computer Science. Plymouth State College of the University of New Hampshire (http://www.plymouth.edu/), Plymouth, NH. Minors in Psychology and Mathematics.

Interests and Personal Accomplishments

- Trustee, Elected to the Durham Public Library Board of Trustees 2005 - 2011 (http://www.durhampubliclibrary.org/).
- Outreach Coordinator of the Seacoast Food Allergy Group (SCFAG) and the Food Allergy & Anaphylaxis Network (http://www.foodallergy.org). Responsible for promotion and marketing.
- UNH Liaison for the Oyster River Parents & Preschoolers (http://www.orppfamilyfun.org/) 2008 - 2011
- Graduate of the New Hampshire Leadership Series (http://www.nhleadership.org) 2005

Technical Skills

Not limited to: Word, Excel, Access, Project, Outlook, PowerPoint, Internet Explorer, Sungard Banner Student, Banner Xtender, SEVIS, SQL, HTML, XML, WebIntelligence, Adobe Professional
Social Media: LinkedIn, Facebook, Twitter, Google+, Foursquare, Klout, Flickr, Path, GetGlue, Pinterest, Untappd

TOWN OF DURHAM
15 NEWMARKET ROAD
DURHAM, NH 03824-2898
Tel: 603/868-5571
Fax: 603/868-5572

AGENDA ITEM: # 9A

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Durham Town Charter

AGENDA ITEM: **RECEIVE ANNUAL REPORT ON THE PLANNING BOARD – PETER WOLFE, CHAIR**

CC PREPARED BY: Jennie Berry, Administrative Assistant

PRESENTED BY: Peter Wolfe, Planning Board Chair

AGENDA DESCRIPTION:

Section 11.1 (I) of the Durham Town Charter requires that the Town Council meet annually with all Chairpersons of standing Town committees to review significant actions taken by the committees, projects currently under discussion, and anticipated activities for the coming year.

Attached for the Council's information is a written report submitted by Planning Board Chair Peter Wolfe. Mr. Wolfe will be present at Monday night's meeting to provide a brief update to the Town Council regarding current activities of the Board.

LEGAL AUTHORITY:

Section 11.1 (I) of the Durham Town Charter.

LEGAL OPINION:

N/A

FINANCIAL DETAILS:

N/A

SUGGESTED ACTION OR RECOMMENDATIONS:

Hear presentation by Peter Wolfe regarding the Planning Board and hold question and answer session if desired.

MEMO TO THE DURHAM TOWN COUNCIL

From: Peter Wolfe, Planning Board Chair

Date: September 21, 2012

Re: Highlights of Planning Board Activity for Previous Year

Amendments to the Zoning Ordinance

- Moved two parcels from the Professional Office District to the Rural District
- Removed eldercare facility as a conditional use in the Rural District, making it a prohibited use.
- Amended the category of uses table to permit light manufacturing anywhere in Retail/Commercial zones

Site Plan Approvals

- Grange Site plan
- Great Bay Kennel site Plan
- 9 Madbury Road LLC– for signage

Subdivision Approvals

- Langey/Hamel on 234 Longmarsh Road
- Grant Development LLC on W. Arthur Court Circle

Public Hearings

- Town of Durham for the Public Library
- UNH for the new police station
- Fairpoint Communications for cutting on a scenic road
- Public Hearing to consider revocation of a previously approved subdivision on Durham Point Road
- Eight lot conservation subdivision on Mill Road
- Proposed zoning ordinance amendments associated with the commercial core strategic plan
- Proposed amendments to the Site Plan Regulations to include Architectural Design Regulations
- Review of Roger Hawk's Architectural Design Guidlines

Major Projects

- Conceptual work on developing master plan – developing process
- Worked with consultant to write the commercial core chapter of the master plan
- Worked with consultant on a strategy to implement the recommendations of the B. Dennis report which led to the development of proposed changes to the commercial core zoning ordinance

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AGENDA ITEM: # 9B

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Public Works Department

AGENDA ITEM: **UPDATE ON THE NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION PROJECT #13080, ROUTE 108 BIKE LANE/SHOULDER WIDENING – NHDOT PROJECT MANAGER RONALD GRANDMAISON, PE**

CC PREPARED BY: Michael Lynch, Public Works Director

CC PRESENTED BY: Todd I. Selig, Administrator
Michael Lynch, Public Works Director
Ronald Grandmaison, NHDOT

AGENDA DESCRIPTION:
The New Hampshire Department of Transportation has carried a Route 108 project consisting of the installation of bike lanes, shoulder widening, and intersection improvements in its Ten Year Transportation Improvement Plan for several years. This Council Communication introduces the "current status" of this NHDOT project by project manager Ronald Grandmaison, PE.

Highlights of the presentation include:
- ✓ Project Background
- ✓ Right of Way Acquisition Process
- ✓ Environmental Review and Findings
- ✓ Existing Conditions
- ✓ Proposed Improvements
- ✓ Project Costs and Schedules

LEGAL AUTHORITY:
N/A

LEGAL OPINION:
N/A

FINANCIAL DETAILS:

Phase A - $2,420,000
80% Federal / 20% State
No Town Funds

Phase B - $4,600,000
80% Federal / 20% State
No Town Funds

TOTAL PROJECT $7,020,000

SUGGESTED ACTION OR RECOMMENDATIONS:

No formal action required. Hear presentation from NHDOT Engineer Ronald Grandmaison and hold question and answer session if desired.

Durham-Newmarket 13080

NH Route 108

Transportation Enhancement Project

Durham Town Council Update

October 1, 2012

New Hampshire DOT
Department of Transportation

Agenda

- Thank you and Introductions
- Project Background
- Right of Way Acquisition Process
- Environmental Review and Findings
- Existing Conditions
- Proposed Improvements
- Project Costs and Schedules

Project Limits

- The overall project begins just south of Bay Road in Newmarket and extends approximately 3.7 miles northerly to the intersection of Mill Pond Road in Durham.
- The first project scheduled to advertise, the “A” project begins 650 feet north of Stagecoach Road and continues north approximately 1.6 miles to Hamel Brook
- The “B” project will be completed in two sections:
  - The first begins just south of Bay Road in Newmarket and continues north to the pavement joint 650 feet north of Stagecoach Road
  - The second section begins at Hamel Brook and continues north to the intersection of Mill Pond Road in Durham

Project Background and Need

- Project originated as a Department sponsored TE project in 1998.
- Route 108 is a critical link in the Seacoast MPO bike network, and heavily used by the UNH bike community.
- The existing roadway is narrow and inadequate for bicycle use with 24 feet of pavement and no shoulders.
- The ADT ranges from 10,000 to 13,000 vpd (in 2002) along the corridor. That was projected to increase to between 16,000 and 20,000 vpd in 2025.
- A number of geometric deficiencies exist along the corridor, primarily at intersections.

Project Background and Need - Cont'd

- Preliminary design by Consultant - Rizzo Associates
- Successful Public Hearing July 21, 2005.
- Report of the Commissioner July 23, 2007.
- In House Design Chief opted to keep design with NHDOT
- Many changes within Department
- May 2011 received Scope of Services and Fee from Statewide on call Consultant (too expensive)
- May 9, 2012 – G&C Approval for "new" Statewide on-Call
- May 10, 2012 – NTP for Statewide On call
- May 25, 2012 – Issued NTP for Final Design
- June 1, 2012 – Formal turnover to Consultant

Project Team

- Design Consultant - CHA - Clough Harbor and Associates
- In-house staff design review and guidance
- In-house Right-Of-Way staff
- In-house Environmental staff
- In-house Utility Relocation/Coordination

Right of Way Process

Durham-Newmarket 13080

New Hampshire DOT Department of Transportation

Environmental Review

- Cultural Resources
  - Historic properties
  - Archeology
- Natural Resources
  - Wetland permits

Current Project Cost and Schedule
13080-A

- $2.42 million
  - 80% Federal / 20% State
  - No Town funds
- Final Design plans – 2012 / 2013
- Right of way acquisition – 2012 / 2013
- Advertise project for bids – **April 8, 2014**
- Begin Construction – June 2014

Current Project Cost and Schedule
13080-B

- $4.6 million
  - 80% Federal / 20% State
  - No Town funds
- Final Design plans – 2013 / 2014
- Right of way acquisition – 2013 / 2014
- Advertise project for bids – **September 9, 2014**
- Begin Construction – April 2015

Hamel Brook Bridge

- Rough estimate developed for Town to prepare FEMA or Homeland Security Grant Application
- Municipally managed project

Durham-Newmarket 13080

New Hampshire DOT Department of Transportation

Coordination with Town

- Sidewalk Maintenance Agreement
- Municipal Work Zone Agreement (MWZA)

Thank You

Plans and presentation are available on Internet

http://www.nh.gov/dot/projects/specifics.htm

TOWN OF DURHAM
15 NEWMARKET ROAD
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AGENDA ITEM: #9C

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Dave Howland, Councilor

AGENDA ITEM: **PRESENTATION AND DISCUSSION REGARDING WATER SUPPLY OVERVIEW AND PRIORITIES**

CC PREPARED BY: Dave Howland, Councilor

PRESENTED BY: Dave Howland, Councilor

AGENDA DESCRIPTION:
In upcoming budget deliberations, the Town Council will discuss whether to connect the Spruce Hole well to the UNH/Durham Water System. In addition to drawing water from the well, the proposed project would include infrastructure to inject Lamprey River water into the aquifer for storage and later withdrawal. The project has been recommended by our staff as a means to provide additional supply and resiliency to the public water system, especially during the summer and early fall when flows are lower on the Lamprey River.

To help place this proposed project in context and better inform our decision on funding it, I have put together a 20-minute presentation to provide an overview of our water system. I will focus on how our system is managed in dry summer months through three drought stages, describe impending state water restrictions on the Lamprey River, and examine how these might affect our supply. Data from two of the driest years on record – 1957 and 2002 – will help illustrate the value of 1) substantive drought conservation measures and 2) an allowance of a fraction of additional flow on the Lamprey River for drinking water. I will provide a brief critique of the scientific and policy assumptions underlying the state's proposed limits on our use of the river and will close with an argument for reasserting the reasonable objections of the UNH/Durham Water system to this emerging policy regime.

LEGAL AUTHORITY:
N/A

LEGAL OPINION:
N/A

FINANCIAL DETAILS:
N/A

SUGGESTED ACTION OR RECOMMENDATIONS:
Hear presentation and hold discussion.

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AGENDA ITEM: # 9D

DATE: October 1, 2012

COUNCIL COMMUNICATION

INITIATED BY: Public Works Department

AGENDA ITEM: **PRESENTATION AND DISCUSSION REGARDING THE SPRUCE HOLE MUNICIPAL WELL & ARTIFICIAL RECHARGE PROJECT**

PREPARED BY: David Cedarholm, Town Engineer

PRESENTED BY: David Cedarholm, Town Engineer
James Emery, Emery & Garrett Groundwater, Inc.
John Brooks, Emery & Garrett Groundwater, Inc.

AGENDA DESCRIPTION:

The groundwater development firm Emery & Garrett Groundwater, Inc. (EGGI) will provide a presentation updating the Town Council on the status of the Spruce Hole Municipal Well (DGD-PW2) and Artificial Recharge Project. EGGI has been working with Underwood Engineers, Inc. on the permitting and engineering of the Project since 2007. EGGI will present an update on the status of the Large Groundwater Withdrawal Permit application and the Final Hydrogeological Investigation Report (Final Report) submitted to the New Hampshire Department of Environmental Services (NHDES) on behalf of the Town and an overview of the work conducted to assess the artificial recharge component of the project. The last update on the project was given at a Town Council in April 2010 and included a presentation from EGGI. A copy of the text from the Final Report and a few of the key figures are attached for the Councilor's review (the full report is 348 pages and the electronic file is 128 mb). Town Engineer David Cedarholm and Michael Metcalf of Underwood Engineers, Inc. will also describe the most cost effective options for connecting the new well to the UNH/Durham Water System's distribution system and the infrastructure to accommodate the artificial recharge (AR).

The new 12-inch diameter 135 foot deep production well was installed in January 2010 and an 8 day pumping test was conducted on the new well in August 2010. The pumping test was intentionally conducted during the driest period of the year in order to obtain a more conservative estimate of how continuous pumping of the well might impact the water level in the aquifer and nearby private wells and water bodies (i.e. wetlands, seeps, streams and brooks). The pumping test is also necessary to estimate the new production well's maximum and sustainable yield. During the

pumping test, the production well was pumped at a rate of 725 gallons per minute (1,044,000 gallons per day) for a total of 8.4 million gallons while 39 monitoring locations were observed. In addition to observing the pre-pumping conditions in the aquifer, these monitoring locations were also observed for an extended period of time after the test was completed to observe the aquifer's ability to recover from the pumping.

Following the 8 day pumping test, EGGI utilized the data collected from the proposed production well, monitoring wells, private wells and surrounding water bodies to develop a numerical groundwater flow model to simulate the hydrologic impact of various long term pumping scenarios. The development of the numerical model requires careful consideration of aquifer's perimeter boundary conditions, and an extensive calibration exercise of comparing simulated water levels within and around the aquifer with actual water levels measured before, during and after the pumping test. In March of 2012 the Final Report was submitted to NHDES in accordance with their Large Groundwater Withdrawal Permit application requirements with the total proposed production volume of 1,044,000 gallons per day, or 725 gallons per minute, with a maximum annual withdrawal volume of up to 63 million gallons. The attached response letter from Christine Bowman of NHDES was received in August 2012 which includes a list of comments that need to be addressed. EGGI has developed a straight forward plan to address each of NHDES comments and will provide a summary of how each comment will be handled.

On a separate and parallel track EGGI has been working on investigating and permitting the AR component of the project which will allow water from the Lamprey River to artificially recharge the Spruce Hole Aquifer. More than 90 percent of the infrastructure needed to accomplish this task already exists, including the pump station on the Lamprey River and 6,500 feet of 16" raw water main leading to within 2,000 feet of the proposed recharge area. A column test was performed in 2011 to assess the ability of the sand and gravel from the glacial deposits within the Spruce Hole Aquifer to treat water from the Lamprey River. The test confirmed that the aquifer did an excellent treating the Lamprey River water as a result EGGI submitted a Groundwater Discharge Permit application in October 2011 necessary to obtain NHDES's approval to conduct the full scale AR pilot test. The pilot test was conducted from March 29, 2012 to June 4, 2012 during which time approximately 20 million gallons of water was pumped from the Lamprey River and discharged into two separate recharge basins. This amount of water raised the water table in the entire aquifer almost 2 feet and after 60 days most of this water had been retained. EGGI will provide a more details from the pilot test and summary of the results.

Underwood Engineers and EGGI developed a conceptual design for the piping and associated infrastructure for connecting the well to the distribution system and to

accommodate the AR. The attached Figure 1 is provided to show the two piping options that were considered. Option A is a piping and valve configuration in that would allow both the withdrawal from the production well and the AR into aquifer to use the same 12" water main. With Option A, it would not be possible to simultaneously withdraw from the production well and artificially recharge the aquifer. The combination of Option A and Option B together provides two separate pipelines so that both withdrawal from the production well and AR into the aquifer can operate simultaneously. The estimated cost of Option A $1.7 million and the estimated cost for Option A+B is $2.1 million. At this time Option A is being recommended. Town Engineer Dave Cedarholm and Mike Metcalf will provide more detail about these options and estimated costs.

LEGAL AUTHORITY:
N/A

LEGAL OPINION:
N/A

FINANCIAL DETAILS:
In 2007, $64,000 was approved from the Capital Fund Budget for phase I of the Project, which included preparation of the preliminary hydrogeologic investigation report and submittal of the large groundwater withdrawal application to NHDES. Phase I also included preliminary engineering of the necessary pipeline and associated facilities. In 2009 the Town Council appropriated $615,000 from the Capital Fund Budget to proceed with the Phases II and III of the project, which includes monitoring well and production well installation, pumping tests, final permitting, and investigating and pilot testing augmenting the aquifer production using Lamprey River water to artificially recharge the aquifer. In 2010, the Town applied for and received an ARRA grant for the AR component of the project in form of 50% principal forgiveness on a $445,000 SRF loan which will ultimately reduce the $615,000 Capital Fund Budget by the amount of $222,500 less interest.

The estimated cost to connect the new production well to the water distribution system with a 12" diameter water main and utilize the same water main and valves to also artificially recharge the aquifer (Option A described above) is $1.7 million.

All project costs are shared one-third by the Town and two-thirds by the University of New Hampshire as customary with all major water and wastewater expenditures.

SUGGESTED ACTION OR RECOMMENDATIONS:
No formal action is required. Hear a presentation updating the Town Council on the status of Spruce Hole Municipal Well and Artificial Recharge project and ask questions/provide comments.

FINAL HYDROGEOLOGIC INVESTIGATION
TOWN OF DURHAM-UNIVERSITY OF NEW HAMPSHIRE
GROUNDWATER DEVELOPMENT
UNH/DURHAM PRODUCTION WELL DGD-PW2

"Final Report" Presented in Accordance with
RSA 485-C:21, NH Env-Dw 302, NH Env-Wq 403,
and NH Env-Wq 2101 Regulations

DURHAM, NEW HAMPSHIRE

March 2012

Presented to:

Mr. David Cedarholm
UNH/Durham Water System

EMERY & GARRETT GROUNDWATER, INC.
56 Main Street • P.O. Box 1578
Meredith, New Hampshire 03253

New England **Mid-Atlantic** **South Atlantic**

Emery & Garrett Groundwater, Inc.

56 Main Street • P.O. Box 1578
Meredith, New Hampshire 03253
(603) 279-4425 www.eggi.com Fax (603) 279-8717

March 28, 2012

Ms. Christine Bowman
New Hampshire Department of Environmental Services
Drinking Water and Groundwater Bureau
P.O. Box 95
29 Hazen Drive
Concord, NH 03301

Dear Ms. Bowman,

Please find enclosed a copy of Emery & Garrett Groundwater, Inc.'s (EGGI's) report entitled, "Final Hydrogeologic Investigation - Town of Durham-University of New Hampshire Groundwater Development – Durham/UNH Production Well #2 (DGD-PW2)," which has been prepared in accordance with NH Env-Dw 302, NH Env Wq-403, and NH Env Wq-2101 regulations.

We hope you find the information contained herein responsive to your needs. If you have any questions, please do not hesitate to contact us.

Best regards,

Daniel J. Tinkham, P.G.	John A. Brooks, Ph.D., P.G.	James M. Emery, P.G.
Senior Hydrogeologist	Senior Geologist	President

LARGE GROUNDWATER WITHDRAWAL PERMIT APPLICATION NOTIFICATION FORM

NOTICE OF SUBMITTAL TO NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

SITE INFORMATION

SITE LOCATION

Site Name:	**Durham/UNH Production Well #2 (DGD-PW2)**
Address:	**Parkers Falls Road, Durham, New Hampshire**
Tax Map/Lot Number:	**13-1**
Municipality(s) in Study Area	**Durham, New Hampshire**
	Lee, New Hampshire
Community Water Supplier(s) in Study Area	**Inn at Spruce Woods**
	Oyster River Condominium
	Better Community Living

SITE OWNER

Site Owner Name:	**Contact: Mr. David Cedarholm, P.E.**
Company Name:	**Durham/UNH Water System**
Contact Address:	**100 Stone Quarry Drive Durham, NH 03824**
Contact Phone Number:	**603-868-5578**
Contact Email Address:	**dcedarholm@ci.durham.nh.us**

APPLICATION PREPARED BY: (provide imprint of professional license stamp if available)

Preparer's Name:	**John A. Brooks, Ph.D., P.G.**
Company Name:	**Emery & Garrett Groundwater, Inc.**
Contact Address:	**PO Box 1578, Meredith, New Hampshire 03253**
Contact Phone Number:	**603-279-4425**
Contact Email Address:	**brooksja@eggi.com**

*Notice to application preparer: Provide copies of certified mail receipts to NHDES immediately following each submittal.

For additional information contact Christine Bowman at (603) 271-8866 or christine.bowman@des.nh.gov or Stephen Roy at (603) 271-3918 or sroy@des.nh.gov .

SUBMITTAL INFORMATION

SUBMITTAL TYPE

__ Preliminary Application
__ Preliminary Application – Supplemental Info.
X Final Report
__ Final Report – Supplemental Information
__ Other: _____

PROJECT TYPE

X Large Community Water Supply
__ Bottled/Bulk Water Supply
__ Other:_____

1. Type of proposed water source: ____ Bedrock well(s), __X__ Overburden well(s) or ____ Spring.
2. Number of proposed water sources: ____1___.
3. Proposed cumulative withdrawal volume in gallons per day:____1,044,000_____.

Project Summary: (please provide a brief description of your proposed project in the space below)

A new groundwater supply well is being developed within Lee, New Hampshire, near the Durham town boundary. This public water supply well will supplement the other water resources available to the Durham/UNH Water System. The new production well is located within glacial sediments adjacent to the Oyster River.

Note: Per RSA 485-C:21, the deadline to request a public hearing for this project is 15 days following receipt of the Preliminary Application or Final Report by New Hampshire Department of Environmental Services. See the attached DES fact sheet WD-WSEB-22-15 regarding the permitting process.

Emery & Garrett Groundwater, Inc.
56 Main Street • P.O. Box 1578
Meredith, New Hampshire 03253
(603) 279-4425 *www.eggi.com* *Fax (603) 279-8717*

FINAL HYDROGEOLOGIC INVESTIGATION TOWN OF DURHAM-UNIVERSITY OF NEW HAMPSHIRE GROUNDWATER DEVELOPMENT UNH/DURHAM PRODUCTION WELL DGD-PW2

"Final Report" Presented in Accordance with RSA 485-C:21, NH Env-Dw 302, NH Env-Wq 403, and NH Env-Wq 2101 Regulations

Durham, New Hampshire
March 2012

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Emery & Garrett Groundwater, Inc.
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FINAL HYDROGEOLOGIC INVESTIGATION TOWN OF DURHAM-UNIVERSITY OF NEW HAMPSHIRE GROUNDWATER DEVELOPMENT UNH/DURHAM PRODUCTION WELL DGD-PW2

"Final Report" Presented in Accordance with RSA 485-C:21, NH Env-Dw 302, NH Env-Wq 403, and NH Env-Wq 2101 Regulations

Durham, New Hampshire
March 2012

I. INTRODUCTION

A. Background

The UNH/Durham Water System currently serves both the Town of Durham, New Hampshire, and the University of New Hampshire (UNH). The Water System is currently investigating the development of additional supply capacity to supplement their existing water sources. Currently, the UNH/Durham Water System relies on withdrawals from the Lamprey River and the Lee Well to meet its demands. A supplementary source of groundwater will enable the Water System to reduce its impact on the Lamprey River during periods of lowest River flows. Emery & Garrett Groundwater, Inc. (EGGI) is submitting this Final Report for the Water System to fulfill the permitting requirements for a new groundwater production well in accordance with New Hampshire Statute RSA 485-C:21 and Administrative Rules Env-Dw 302 *(Large Production Wells for Community Water Systems)*, Env-Wq 403 *(Large Groundwater Withdrawals)*, and Env-Wq 2101 *(Water Conservation)*.

Production Well #2 (also known as Well DGD-PW2) is located in Lee, New Hampshire, just west of the Durham-Lee town line and east of Packers Falls Road (Figure 1). The Production Well withdraws groundwater from a sand and gravel aquifer that is herein called the Spruce Hole Aquifer. This Aquifer is located within the Chesley Brook Watershed, a tributary of the Oyster River Watershed (Figures 1 and 2).

Underwood Engineers, Inc. (UEI) and Emery & Garrett Groundwater, Inc. (EGGI) have been retained by the UNH/Durham Water System to conduct an evaluation of the water resource potential that could be produced from the proposed Production Well and the Spruce Hole Aquifer. The preliminary findings for this project were presented to the NHDES in EGGI's 2008 report entitled, *"Preliminary Hydrogeologic Investigation, Town of Durham-University of New Hampshire, Groundwater Development, Durham/UNH Production Well #2, Durham, New Hampshire"*.

This report presents the findings of the long-term pumping test conducted on Production Well DGD-PW2 and addresses the following issues:

- Recommendations for the establishment of a Permitted Production Volume (PPV) that will determine future groundwater withdrawals from the Spruce Hole Aquifer;
- Identify all impacts that pumping of Production Well DGD-PW2 will have on other water resources in the area;
- Establish a Wellhead Protection Area (WHPA) around Production Well DGD-PW2;
- Make recommendations for the mitigation of impacts to other water users.

B. Project Management Information

1) Name of Project

UNH/Durham Production Well #2 (Well DGD-PW2)

2) Name and Address of Owner

UNH/Durham Water System
c/o Town of Durham Public Works Department
Mr. David Cedarholm
Assistant Director of Public Works and Superintendent
Town of Durham
100 Stone Quarry Drive
Durham, NH 03824
(603) 868-5578

3) Name and Address of Groundwater Consultant

Emery & Garrett Groundwater, Inc.
James M. Emery, PG, President
John Brooks, Ph.D., PG, Project Manager
Dan Tinkham, M.S., PG, Senior Hydrogeologist
56 Main Street/P.O. Box 1578
Meredith, NH 03253
(603) 279-4425

4) Requested Permitted Production Volume (PPV)

The permitted production volume requested for Production Well DGD-PW2 includes a two-tier structure:

- A maximum withdrawal of 1,044,000 gallons per day (gpd) (725 gallons per minute [gpm]) for a maximum of 60 days per year (Total annual withdrawal of 63 million gallons) or,
- A maximum withdrawal rate of 172,800 gallons per day (120 gpm) with no restriction on the number of days pumped (Total annual withdrawal of 63 million gallons).

In order to maintain the most flexibility for the UNH/Durham Water System, we propose that these two tiers provide the end members along a continuum of possible pumping scenarios, with total *annual* withdrawals limited to 63 million gallons. One of the primary goals for developing the new water supply well is to take advantage of the large storage capacity of the Spruce Hole Aquifer to meet the high Water System demands in September and October, when the University is back in full session and water withdrawals from the Lamprey River are restricted due to low flows. In addition, there may be times when the Water System requires the input from additional water supplies during the rest of the year (e.g., if another water supply source is interrupted or substantial fire flow is needed, etc.).

C. Hydrogeology of the Spruce Hole Aquifer

The glacial deposits that comprise the aquifer materials near Production Well DGD-PW2 were laid down during the recession of the last continental ice sheet that blanketed the region. The advance and retreat of the glacier had a profound impact on the existing topography of the bedrock surface and the distribution of unconsolidated materials.

As the glacier retreated through the region, the sea level at that time was in direct contact with the glacier. As melting proceeded, the glacier withdrew episodically in a northwestward direction; periods of melting and withdrawal were followed by episodes of stagnation and perhaps even glacial re-advancement. At each of the stagnation points, a new sequence of sand and gravel deposits were laid down in front of the ice margin as marine deltas and other types of melt water deposits were formed. In order to illustrate the complexity of the geologic setting, Figure 3 presents the published surficial geologic map of the area. Furthermore, Figure 4 provides a contour map of bedrock surface elevations, and Figure 5 shows three schematic geologic cross-sections through the Spruce Hole Aquifer.

Scouring of the pre-glacial topography by the glacier resulted in the development of an approximately east-southeast trending bedrock trough in the area of proposed Production Well DGD-PW2 (Figure 4). The presence of this over-deepened trough is a critical component of the viability of the Spruce Hole Aquifer as a water resource because it results in greater amounts of groundwater storage within the Aquifer and locally increases the thickness of saturated sediment.

As the glacier retreated, it stagnated temporarily in the area just south of the intersection of Packers Falls and Mast Roads. During this period of stagnation, sediments flowing from melted tunnels within the ice sheet were deposited in the ocean into a marine delta. The coarse-grained sediments settled quickly, forming the highly permeable core of the Aquifer. The published surficial geologic map of the Aquifer shows the presence of a coarser-grained unit (shown as Qmwd on the surficial map, Figure 3) in two dimensions. In reality, the coarse-

grained, saturated sediments that form the core of the Aquifer are concentrated in a smaller area within that unit shown on the map. The Aquifer core is partially covered and surrounded by less-permeable well-sorted sands that provide for large quantities of groundwater storage (shown as Qps, Sandy Presumpscot Formation on Figures 3 and 5).

As the glacier receded towards the northwest, the source of the sediments became more distant and fine sands, silts, and clays of the Presumpscot Formation were deposited into the ocean around the Spruce Hole delta. These deposits drape over portions of the marine delta and fill the surrounding lowlands (Qpc – Presumpscot Formation). The silt/clay portions of the Presumpscot Formation are hydraulically unfavorable for groundwater development.

The glacial deposits have, in part, been eroded and re-worked by late glacial to post-glacial streams and rivers. In addition, wetlands have developed on top of the finer-grained sediments (such as along Chesley Brook[1]) and in areas of poor topographic drainage (Figure 3).

As the glacial period ended, ice that had been buried beneath the delta melted and the overlying deltaic sediments collapsed into voids left by the melted ice to form glacial kettle holes. The largest and most unique of the kettle holes is known as Spruce Hole Bog (Figure 6). The postglacial deposition of fine sediments and development of wetlands (the Spruce Hole Bog) within the kettle hole have gradually filled in the lower portions of the kettle hole (Miller, 1996). The impermeable peat beneath the wetland prevents the flow of water from the Spruce Hole Bog into the underlying Aquifer, resulting in a "perched" water table within the Bog.

II. WELL LOCATION RELATIVE TO SURFACE WATER (Env-Dw 302.05)

Production Well DGD-PW2 is located approximately 1,000 feet northeast of a small tributary of Chesley Brook and approximately 600 feet from standing water in Spruce Hole Bog (Figure 6).

Floodplain maps downloaded from the US Federal Emergency Agency (FEMA) Map Service Center Internet website were used to determine floodplain locations relative to the proposed Production Well (Figure 7). The floodplain maps indicate that Production Well DGD-PW2 is 850 northeast of the closest 100-year floodplain boundary. The elevation of Production Well DGD-PW2 is approximately 40 feet higher than the 100-year floodplain boundary.

III. SANITARY PROTECTIVE AREA (Env-Dw 302.06)

A 400-foot Sanitary Protective Area (SPA) around Production Well DGD-PW2 includes four properties, three of which are owned by the Town of Durham (Figure 6). Production Well DGD-PW2 is located within Durham's town-owned gravel pit in Lee, New Hampshire (Lee Tax Lot # 0015000109). The Lee-Durham town line is approximately 250 feet east of the Well. The DGD-PW2 SPA includes three lots in Durham, two of which are owned by the Town of Durham (Lots 13-1 and 13-5).

[1] Chesley Brook is incorrectly shown on the USGS 7.5 minute topographic maps as "Chelsey" Brook.

The only lot within the SPA not owned by the Town of Durham is Durham Lot 13-2, which is owned by Mr. Joseph N. Colasante (Figure 6). The portion of Lot 13-2 that occurs within the SPA is "landlocked" because access to it is through Town-Owned property or wetlands. Because this will restrict future development, the UNH/Durham Water System will be requesting a waiver from having to obtain legal control over the portion of Lot13-2 that occurs within the DGD-PW2 SPA. That waiver request letter will be submitted under separate cover.

IV. PREPARATION FOR THE EIGHT-DAY PUMPING TEST PROGRAM

A. Modification of the Proposed Groundwater Monitoring Plan

1) Introduction

A number of changes to the proposed monitoring plan were required due to issues beyond the control of EGGI. All of the modifications to the plan were approved by the NHDES prior to the start of the pumping test program. A summary of the changes to the monitoring plan is presented below.

2) Existing Monitoring Wells

Existing monitoring locations were utilized during the pumping test program when feasible (Figure 8). As proposed in the Preliminary Hydrogeologic Report, the following existing monitoring wells and piezometers were used:

- The eight-inch-diameter test well, UNH-TW;
- Eight, two-inch-diameter monitoring wells (identified as Wells MW-101 through MW-108). These wells were installed during an earlier investigation and response tests confirmed that all eight of these wells showed hydraulic connection with the Aquifer; and
- Two existing piezometers (MW-202M and MW-206A) were also utilized during the testing program.

Several changes were made to the original plan because the existing piezometers were not hydraulically connected with the Aquifer or were difficult to monitor. The existing shallow monitoring well MW-3A was used instead of the shallow well at the MW-202M site. EGGI elected to install new monitoring wells, DGD-M7 and DGD-M7s, to replace the need to monitor piezometers MW-209 and MW-210. Piezometer MW-205 was replaced with a new monitoring well named DGD-M6

3) New Monitoring Wells and Piezometers

EGGI proposed the installation of five monitoring wells (DGD-MW1 through DGD-MW5 and three piezometers (DGD-P1 through DGD-P3) in the Preliminary Hydrogeologic Report for Well DGD-PW2. However, permission to drill monitoring wells DGD-M1, DGD-M2, DGD-M3, and DGD-M5 could not be obtained from owners of the lots on which the wells

were to be drilled. In addition, permission to install piezometers P1 and P2 were not received from the property owners.

EGGI subcontracted Great Works Test Boring, Inc. of Rollinsford, New Hampshire, to install seven new monitoring wells in preparation for the DGD-PW2 pumping test: Wells DGD-M1 (new location), DGD-M4, DGD-M6, DGD-M7, DGD-M7s, DGD-T1, and DGD-T4 (Figure 8 and Table I). These wells were drilled to provide detailed stratigraphy in strategic locations and to provide representative water level monitoring locations. A layer of clay was intercepted during the drilling of Well DGD-M7, so a shallow well (DGD-MW7s) was also installed at this site. The deeper well (DGD-M7) is screened within the Aquifer below the clay layer, whereas the shallow well (DGD-MW7s) was screened above the clay to monitor the perched water table on top of the clay. Although EGGI attempted to use Well DGD-M7s as a monitoring location, the shallow perched water table on top of the clay in which the well was located drained away by the start of the pumping test program.

In addition, EGGI manually installed five shallow piezometers (DGD-P1 through P5) to enable monitoring of shallow water tables near surface water and wetlands (Figure 8 and Table I). Only the DGD-P3 piezometer was installed at the location proposed in the Preliminary Hydrogeologic Report. Piezometer DGD-P1 was installed in the shallow peat of Spruce Hole Bog to help determine if pumping impacts can be seen in the peat below the bog's surface. The DGD-P2 piezometer was moved to the right-of-way along Jenkins Road to monitor water level changes in Chesley Brook upgradient of the proposed location. Piezometers DGD-P4 and DGD-P5 were used to monitor potential wetland impacts in two small "pocket" wetlands in the area of Monitoring Well DGD-M7.

Each of the installed monitoring wells and piezometers were developed to ensure that a hydraulic connection existed between screens and the surrounding Aquifer.

4) Surface Water Stations

EGGI originally proposed the establishment of surface water stations DGD-SW1 through DGD-SW5 to monitor water level changes and flows within Chesley Brook and small tributaries to the Oyster River. Unfortunately, permissions from private landowners could not be obtained for the proposed DGD-SW1 and DGD-SW3 sites.

Surface Water Station DGD-SW1 was moved to be located near Piezometer DGD-P1 in Spruce Hole Bog to monitor the elevation of standing water relative to shallow groundwater (DGD-P1) and deeper groundwater (MW-202M) (Figure 8). The DGD-SW3 surface water station was relocated to monitor flow within the tributary along which Piezometer DGD-P3 was installed. The other three surface water stations were established near to, but not at, the specific location proposed in the Preliminary Hydrogeologic Report.

Although surface water station DGD-SW1 was established to monitor water level variations, the other surface water stations were setup to monitor stream flows. Stream flow within Chesley Brook was measured within a culvert crossing beneath Jennings Road using an automated water flow recorder incorporating Doppler radar technology. Stream flows at the

other surface water stations were monitored using automated water level recorders to record stream stage. A rating curve (stage versus flow relationship) was created for each station in order to relate variations in stream stage to actual flow rates (Appendix A).

It had been our hope that a surface water station could be established on Chesley Brook just upstream of the Chesley Brook Springs so that spring flow could be bettered quantified. Unfortunately, permission from the private landowner to establish such a station was denied. Therefore, surface water flow in Chesley Brook could only be monitored at a single station (DGD-SW4) located just above its confluence with the Oyster River.

Background surface water flow measurements from the Oyster River were available from the USGS gaging station (#01073000 Oyster River near Durham, NH) located approximately 1.5 miles from Production Well DGD-PW2 (Figure 2).

5) Domestic and Public Water Supply Wells

EGGI sent letters to property owners of 23 lots in Lee and Durham, New Hampshire, in an effort to obtain well construction information and permission to monitor domestic wells during the pumping test (Appendix B). Seven domestic well owners responded affirmatively to the request for monitoring. Water levels in six of those wells were monitored throughout the pumping test program using automated water level recorders (Table I). Although monitoring permission was granted from the owner of lot 14-2, there were no wells on the property to monitor.

In addition to the six domestic wells monitored, permission was also obtained to monitor two bedrock public supply wells in the area (Inn at Spruce Woods Well 2 and Packers Falls Village) (Table I and Figure 8). The Inn at Spruce Woods utilizes two bedrock wells in close proximity to each other; so only one was monitored during this testing program.

6) Climatic Monitoring

A rain gauge and recording barometer were installed on site. In addition, a local rain gauge maintained by the University of New Hampshire at the Thompson Farm site was also utilized to provide long-term climate observations (Figure 9).

B. Detailed Information Regarding Work Tasks Completed in Preparation of Pumping Test

1) Selection of Production Well Site

Previous hydrogeologic studies on the Spruce Hole Aquifer suggested that the aquifer proximal to the UNH-TW well site was favorable for groundwater development (Ballestero and Lee, 2000, and Ballestero et al, 1995). However, the UNH/Durham Water System wanted to determine if a new municipal water supply well could be developed within the Durham Town limits. EGGI therefore contracted Great Works Test Boring, Inc. to drill exploratory test wells DGD-TW1 through DGD-TW4 to investigate potential alternate production well sites to the

UNH-TW site (Figure 8; Appendix C). The stratigraphic insights gained from the exploratory test well drilling supported the installation of Production Well DGD-PW2 proximal to the UNH-TW well.

2) Construction of Proposed Production Well DGD-PW2

Boart-Longyear Corporation of Northborough, Massachusetts, was subcontracted to perform the drilling of Production Well DGD-PW2 in December 2009. The well boring was drilled utilizing a dual-wall casing advance method. A 24-inch-diameter surface casing was initially pounded into the ground to a depth of 30 feet. As 18-inch-diameter "drill" casing was then rotated into the ground within the 24-inch-diameter surface casing, material inside the drill casing was airlifted to the ground surface using a roller cone drill bit and pressurized water and air.

Following the completion of the drilling, a hydrogeologic log of the well was created from field analyses of sediments evacuated from the boring (Appendix C). In addition, sieve analyses of sediment samples collected from the lower portion of the borehole were completed by Boart-Longyear to determine grain size distribution at the depth where the well screen would be installed. The sieve results led to the selection of two different screen openings -- 90-slot (0.090-inch) from 95 to 100 feet below grade and 125-slot (0.125-inch) from 100 to 130 feet (Table I and Appendix C).

Production Well DGD-PW2 was constructed with 12-inch-diameter stainless steel screen and heavy-walled steel casing. The annulus between the 18-inch-diameter drill casing and the 12-inch-diameter well was filled with 1/4" X 1/8" gravel pack from 90 to 135 feet below ground surface. Transition sand was added to the annulus from 62 to 90 feet and the annulus between 62 feet and the ground surface was filled with cement/bentonite grout. The drill casing was gradually removed from the ground as well construction proceeded. The 24-inch-diameter surface casing was left in place to provide an extra level of protection to the Well in the event that the Water System decides to lower the ground surface around Production Well DGD-PW2 to a level closer to the existing sand pit floor.

Following the construction of Production Well DGD-PW2, the well screen was developed via pumping and surging to remove any fine material from the gravel pack and the nearby formation. The developed gravel pack provides an efficient means to transfer water from the Aquifer into the Production Well. A properly developed well prevents the migration of formation material into the well, increases well efficiency, and leads to reduced maintenance costs over the life of the well.

3) Surveying of Monitoring Locations

Atlantic Survey Company (ASC) of Durham, New Hampshire, performed location and elevation surveys of the Production Well and selected monitoring locations (Tables I and II). The measuring point on each of these monitoring locations was surveyed to tolerances of 0.1 feet vertically and one foot horizontally. Monitoring locations that were not surveyed by ASC were located horizontally by EGGI utilizing a Trimble high-resolution GPS. Vertical elevations

assigned by EGGI were estimated based on detailed LIDAR survey imagery obtained through the University of New Hampshire.

4) Installation of Water Level Recorders

Automated water level recorders were installed in proposed Production Well DGD-PW2 and all but two of the monitoring wells, piezometers, and surface water stations. Two locations, MW-206A and MW-3A, were monitored by hand during the pumping interval because they are 0.5-inch-diameter wells and available automated water level recorders could not fit into these wells.

Monitoring occurred throughout the pumping test program using the collection intervals indicated on Table III. The collection intervals for the automated water level records were all less than, or equal to, 0.5 hours (30 minutes). Groundwater and surface water level measurements were obtained periodically by hand to aid in the calibration of the water level data collected using the automated equipment.

5) Bacterial Analyses of Domestic Well Water

Prior to the installation of water level recorders in all domestic and public supply wells, water samples were collected from the wells and submitted for laboratory analyses to determine if Total or Fecal Coliform bacteria were present. The initial round of sampling showed the presence of Total Coliform bacteria in two domestic wells, Lee and Tsukrov (Figure 8 and Appendix B). NHDES personnel notified the owners of these wells prior to EGGI's installation of water level recorders.

Groundwater samples were also collected from the wells following the removal of monitoring equipment to ensure that monitoring did not contribute to the introduction of bacteria into the wells (Appendix B). The Lee Well showed the presence of Total Coliform bacteria after the testing program, so conditions had not changed during the pumping test program. However, the Tsukrov Well showed Total and Fecal Coliform bacteria after the monitoring program, showing a change from pre-monitoring conditions when only Total Coliform was present. It was not determined if the Fecal Coliform was introduced during the installation of the monitoring equipment or if the construction of the Tsukrov Well (a shallow dug well constructed of cement tiles) contributes to bacterial contamination; independent of any monitoring that may be performed. EGGI chlorinated the Tsukrov domestic well and re-sampled to ensure that any bacteria that could have been introduced during the monitoring interval were eliminated. Re-testing of the Tsukrov Well proved that the well was sanitary (devoid of Fecal Coliform and Total Coliform) following the chlorination.

V. IMPLEMENTATION OF THE EIGHT-DAY PUMPING TEST PROGRAM (Env-Dw 302.15 and Env-Wq 403.14)

A. Purpose of the Pumping Test Program

A multiple-phase pumping test program was designed to evaluate the yield and quality of water produced from proposed Production Well DGD-PW2. The specific objectives of the pumping test program conducted included the following:

1) Refine the Preliminary Wellhead Protection Area (WHPA).
2) Determine the Permitted Production Volume (PPV) (to determine the sustainable yield capacity of the Well and Aquifer). The requested PPV incorporates two pumping scenarios -- continuous long-term pumping withdrawals and a shorter duration, higher-yielding withdrawals).
3) Provide background data necessary to address issues related to groundwater resource development, such as the potential for adverse impacts to occur as a result of long-term groundwater withdrawals.
4) Compile information to address data gaps in the preliminary conceptual model of groundwater flow in the Spruce Hole Aquifer.
5) Assess the quality of local groundwater resources under long-term pumping conditions.

B. Pumping Test Design

The pumping test program was designed to meet or exceed the requirements set forth by NHDES regulations (Env-Dw 302.11). For the purposes of this groundwater supply development program, a multi-phase pumping test design was adopted. The design work included the following Phases:

- Phase I – Monitoring pre-pumping water levels at all groundwater and surface water stations;
- Phase II – Perform a step-drawdown test on Production Well DGD-PW2.
- Phase III – Conduct an eight-day, constant rate pumping test on Production Well DGD-PW2; and
- Phase IV – Post-pumping monitoring of the recovery of both surface water levels and groundwater levels.

Climatic data was collected throughout all four phases of the pumping test program.

1) Design of Phase I – Pre-Pumping Monitoring

Pre-pumping monitoring consisted of recording surface water and groundwater levels at most monitoring stations for at least ten days prior to the start of pumping.

2) Design of Phase II - Step Drawdown Test of Production Well DGD-PW2

Step drawdown testing was performed on Production Well DGD-PW2 several months prior to the eight-day pumping test on February 25, 2010. The step drawdown test consisted of pumping the Well at sequentially higher rates for two- to three-hour intervals. The results of the tests were used to select the pumping rate to be used during the eight-day pumping test.

3) Design of Phase III – Eight-Day Pumping Test

The eight-day pumping test consisted of pumping proposed Production Well DGD-PW2 for eight days beginning on August 19, 2010. The original start date for the pumping test was August 18, but several hours into pumping a generator failure forced a shutdown, with re-start the next day. Once re-started, pumping continued uninterrupted for eight days at a rate of 725 gpm, with the exception of two brief shutdowns to resolve generator problems about seven days into the pumping program.

Production Well DGD-PW2 was tested using a submersible electric pump powered by a diesel generator. A gate valve located on the discharge line was used to control the pumping rate. A spigot was installed on the discharge line near the Well to allow for easy collection of water samples. In addition, a 1-inch-diameter, open-ended access tube was attached to the pump drop pipe to allow the safe installation of a water level measuring probe near the top of the pump. Following the installation of all pumping equipment, the Well was disinfected with chlorine bleach. Accurate discharge (yield) measurements were obtained using an orifice weir installed at the end of the water discharge line.

The discharge water from Production Well DGD-PW2 was conveyed approximately 1,900 feet across the marine delta top and discharged into an existing unused pipeline that is owned by the UNH/Durham Water System (Figure 6). That pipeline carried the discharge water to the Oyster River, a short distance upstream of Monitoring Well DGD-M4 (Figures 6 and 8). A temporary surface water discharge permit (Site# 201007004 / RSN# 24467 / Activity # 159716) was obtained from NHDES before the testing program began (Appendix D).

4) Design of Phase IV - Recovery Test Design

Water level measurements were taken at all monitoring sites, including the Production Well, for a minimum of 11 days *following* the end of the pumping period.

VI. RESULTS OF THE EIGHT-DAY PUMPING TEST PROGRAM

A. Evaluation of Ambient Hydrologic Conditions (Pre-pumping)

The eight-day pumping test on Production Well DGD-PW2 was carried out after a prolonged dry period during the summer of 2010. Two rain events occurred during the pumping test program; 1.5 inches of rain occurred on Day –10 and 3.4 inches of rain fell on Day 7. After the pumping test had started, the weather forecast predicted a fast moving storm that would pass

through Durham on Day 6 or 7 of the pumping test. It was anticipated that rain from this storm would potentially result in significant water level and stream flow changes during the original starting period of post-pumping recovery (i.e., Day 6 and 7). Such weather related impacts could have potentially masked water level and stream flow recoveries related to the end of pumping Well DGD-PW2. Therefore, a decision was made to extend the pumping test to eight days in the hope that the most significant weather-induced hydrologic changes would have subsided by the start of the recovery period of monitoring.

During the week prior to pumping, surface water locations on all streams showed little variation in flow, as the most recent precipitation had occurred ten days before pumping began and the streams were experiencing base flow conditions (Figure 9 and Plate 2). The stream flow data (Station DGD-SW2) show that base flow for the southern portion of the Chesley Brook Watershed (i.e., upgradient of Jenkins Road) is approximately 24 gpm. Pre-pumping base flows in the Oyster River tributaries north (Station DGD-SW3) and northeast (Station DGD-SW5) of the Aquifer were approximately 10 gpm and 65 gpm, respectively. By contrast, base flow in Chesley Brook east of Packer Falls Road (Station DGD-SW4) was approximately 450 gpm prior to the start of pumping.

In contrast to the relatively steady surface water flows observed, the groundwater levels measured continuously declined throughout the pre-pumping period (Plate 1). The pre-pumping groundwater level data reflects the gradual draining of the Spruce Hole Aquifer during the prolonged dry period without recharge to replenish the Aquifer. The groundwater level declines can be closely approximated with a simple linear decline, so ambient corrections to the data were easy to model.

Groundwater and surface water elevations at the time pumping began (August 18, 2010) were used to create a pre-pumping contour map of groundwater elevations (Figure 10). The contour map shows a very flat water table in the vicinity of the Production Well (the core of the Aquifer). A steep water level gradient occurs east of Well DGD-PW2 along the contact between the Presumpscot Formation and the sandy deltaic sands. The water table slopes moderately towards Chesley Brook to the north of the Wong domestic well and Well DGD-M7.

Mounding of the water table occurs south of the Production Well within relatively fine deltaic sediments and to the northeast of the Well beneath a till hill. These mounds form a local groundwater divide within the Aquifer (Figure 10).

The groundwater contour map suggests that, under ambient conditions, groundwater flows radially from the areas where the groundwater is mounded. Some (< 50 gpm) groundwater flows south and southwestward of the local groundwater divide into the upper portion of the Chesley Brook Watershed (Figure 10). A short distance east of Spruce Hole Bog, groundwater flows eastward from the local groundwater divide into a tributary of the Oyster River. This tributary was monitored using the DGD-SW5 surface water station.

The dominant groundwater flow direction within the Spruce Hole Aquifer is northwards towards springs (herein called the Chesley Brook Springs) that are located on the south side of

Chesley Brook just west of Packers Falls Road. Groundwater upwelling out of the springs likely passes through "windows" within the Presumpscot Formation.

Based on the pre-pumping groundwater elevation contour map, the contributing area for these springs encompasses an area of 124 acres (Figure 10). The Chesley Brook Springs therefore represent a significant sink for groundwater flow *in the Spruce Hole Aquifer*. Assuming groundwater recharge rates of 20 to 24 inches per year, the 124-acre contributing area could supply approximately 128 to 153 gpm of spring flow to Chesley Brook, or only approximately 30% to 38% of the base flow measured before the pumping test program.

B. Results of Step Drawdown Testing

The step drawdown testing of Well DGD-PW2 included three steps at different pumping rates. The first step continued for two hours with a final pumping rate of 280 gpm (Figure 11). For the first 90 minutes of the first step, the Well was actually pumped at a lower rate (unknown) until a problem with the orifice weir was discovered. The second and third steps each lasted for three hours at rates of 530 gpm and 780 gpm, respectively. As expected, the specific capacity declined as the discharge rate increased, with a final specific capacity of 62.7 gpm/ft at the end of the last step. This is a very favorable specific capacity for a sand and gravel aquifer.

A total drawdown of approximately 59 feet is available between the water level in the Production Well and the top of the well screen (which is located at 95 feet below ground surface). At the end of the step drawdown test, at a rate of 780 gpm, 47 feet of available drawdown still remained in the Well. The step test results suggested that Well DGD-PW2 could be pumped at a rate exceeding one million gallons per day (694 gpm) during a long-term pumping test without the risk of lowering the water level in the Well below the top of the well screen. Therefore, it was decided to pump Production Well DGD-PW2 at 725 gpm (1,044,000 gpd) for the duration of the eight-day pumping test, in order to evaluate whether the Well could also be utilized to meet short-term periods of high water supply demand experienced by the UNH/Durham Water System.

C. Water Level Responses Observed During Eight-Day Pumping Test

1) Response of Production Well DGD-PW2 During the Pumping Interval

As noted earlier, the constant-rate pumping test of Well DGD-PW2 commenced on August 19, 2010 (Table IV). Within a few minutes of the start of pumping, the water level in the Well declined from the pre-pumping level of 36.70 feet to approximately 49 feet (Figures 12 and 13 and Appendix E). Following that initial rapid drawdown, the water level in the Well lowered very gradually during the next seven days, eventually declining to a level of 52.48 feet below the top of casing. Seven days into the eight-day pumping period, a generator malfunction resulted in a minor shutdown resulting in a rapid rise in water level. When the pump was restarted, the discharge rate increased slightly from that used before the shutdown, resulting in a slight drop (around 0.5 feet) in the pumping water level compared to the level measured prior to the generator malfunction (Figures 12 and 13). However, the rate of water level decline in the Well for the last day of the test was similar to that prior to the malfunction.

The water level in the Well was 53.14 feet (below the top of the well casing) at the end of the pumping test period. The total pumping-induced water level drawdown in the Well (change in water level attributed to pumping only, negating ambient influences) during the eight days of testing was calculated to be 16.19 feet. The specific capacity of the Well at the end of the eight-day pumping test was 44.8 gpm/ft.

When water level is plotted against logarithmic time, the water level response plot shows a linear trend for the first half-day of pumping (Figure 13). After that time, the slope of the response plot continuously increased for the duration of the test. This type of response is typical of aquifers that are of limited dimension and have barrier boundary conditions. These responses physically limit the aquifer and prevent the expansion of the cone of depression.

2) Water Level Responses Observed at Monitoring Locations During the Pumping Interval

Water level responses to pumping of Production Well DGD-PW2 were observed at 15 monitoring locations, including 13 Monitoring Wells and two Domestic Wells (Table II, Plate 1, and Appendix E). Pumping-induced drawdown ranged from a high of 12.36 feet in UNH-TW,[2] to as little as 0.17 feet in Well MW106 (Figure 14; Plate 1).

The monitoring locations, where pumping induced water level impacts occurred, can be grouped into two Response Types (Figure 14; Plate 1):

- **Response Type #1** – These included wells having water level responses that mimic the response of pumping-induced water level in the Production Well. In other words, rapid water level drawdown is observed early in the test followed by gradual drawdown throughout the remaining pumping interval. After pumping is terminated, an immediate, but partial, recovery occurs. The following wells are included in this first category of pumping test responses: UNH-TW, DGD-T1, DGD-T4, MW101, MW102, MW2026a, and the Wong residential well (Plate 1 and Appendix E). Wells with these responses are screened within the core of the most transmissive deposits proximal to the Production Well (DGD-PW2).

- **Response Type #2 –** This water level response occurred at the other monitoring well sites where pumping-induced water level impacts were measured. This Response Type is typified by the following: 1) initial delayed water level responses to pumping (e.g., DGD-M6) followed by, 2) rapid water level responses (e.g., DGD-M7), 3) water level declines that are generally linear throughout the pumping interval, and 4) include wells having essentially no water level recoveries after the termination of pumping (e.g., DGD-M7) (Plate 1 and Appendix E). These water level responses are indicative of groundwater monitoring sites located within finer portions of the

[2] UNH-TW is located only five feet from the pumping well.

Aquifer that surround the more transmissive Aquifer core. *Water level responses at these locations may be more a function of the distance from the nearest portion of the transmissive Aquifer core, rather than the distance to the Production Well.*

The results suggest that the cone of depression expanded more quickly within a northwest oriented core of coarse-grained sediments than within the portion of the Aquifer having finer sediments. The lack of full water level recoveries within all of the monitoring wells with pumping-induced water level impacts indicates that some amount of groundwater was removed from storage during the pumping test. The water table in the finer-grained deposits (Response Type #2) continued declining, or simply flattened, during recovery as water from the finer sediments continued to drain into, and fill, the cone of depression that remained within the coarse sediments after the pumping test. This recovery response reflects the fact that water levels outside the core of the Aquifer were still re-equilibrating to the lower water level in the Aquifer core and were not being directly influenced by short-term changes in the configuration of the cone of depression. Although these portions of the Aquifer are less transmissive, they provide large volumes of groundwater storage that can drain into the core of the Aquifer under long-term pumping conditions.

These two types of responses generally correspond with two of the surficial geologic units described earlier and shown on Figure 3. The two-dimensional representation of the surficial geology does not fully represent the complex geometry of the subsurface, but many of the Type #1 Responses (the Aquifer core) are found within the "Marine Delta (Qmwd)" deposit and Response Type #2 (the surrounding material) wells are screened in the finer-grained "Sandy Presumpscot Formation (Qps)".

Neither of the two domestic wells, which were impacted by the pumping of Production Well DGD-PW2, were limited in their ability to provide water to the homeowners. The Wong Well is a deep bedrock well and showed a very small amount of impacted water level drawdown (3.42 feet) relative to its available drawdown. However, the Tsukrov Well is a shallow dug well and the pumping-induced drawdown (1.49 feet) accounted for a significant amount of available drawdown. Therefore, there is concern regarding the impact of prolonged pumping from Well DGD-PW2 on the Tsukrov Well (to be discussed later).

3) Water Level Responses Observed at Shallow Piezometers and Surface Water Stations During the Eight-Day Pumping Test at 725 gpm

The pumping of Well DGD-PW2 did not have any impact on the water levels observed in the five piezometers monitored, or in the Spruce Hole Bog water level at DGD-SW1. In addition, water flow records determined for the other four surface water stations demonstrated that there were no pumping-induced flow variations within the small tributary streams to the Oyster River (Stations DGD-SW3 and DGD-SW5) or to Chesley Brook (Stations DGD-SW2 and DGD-SW4) (Figure 8 and Plate 2).

The fact that there were no water level impacts within Piezometer P-1 and at Surface Water Station DGD-SW1 confirms that the Spruce Hole Bog is perched above the groundwater

table and, therefore, cannot be impacted by the pumping-induced lowering of the water table in the Spruce Hole Aquifer. The lack of pumping-induced water levels in the other four piezometers (all installed within shallow soils or wetlands on top of the clayey Presumpscot Formation) shows that the cone of depression that developed during the pumping was not hydraulically connected with the thin, perched, saturated zones or wetlands on top of the Presumpscot Formation at the sites monitored.

The graph of flow rates in Chesley Brook indicates that stream flow declined by approximately 50% in the six days following the pumping interval. Such a flow reduction might be indicative of a pumping-induced impact on Chesley Brook flow (Figure 15). Unfortunately, the timing of the storm during the pumping test prevented a robust analysis of the flow data obtained at the end of pumping and beginning of recovery. EGGI suspects that the observed post-pumping stream flow reduction may reflect a change that occurred in the streambed morphology during the flooding that accompanied the storm (e.g., widening of the streambed). Such a change would likely have an impact on the stage/discharge relationship (i.e., the rating curve) defined for pre-storm conditions. As a result, the use of stage measurements obtained after the storm to calculate flow may have resulted in a mistaken underestimation of flow within Chesley Brook. This could be misinterpreted as a significant impact to the flow of the Chesley Brook as a result of pumping. Assessing the potential for long-term pumping-induced impacts to the flow within Chesley Brook is discussed further in Section XI of this report.

D. Results of Monitoring Water Level Recovery

Water level recovery in the transmissive core of the Aquifer (area of wells having Response Type #1, as described previously) was relatively rapid during the first four to six hours following the termination of pumping and then gradually slowed for the remainder of the monitoring period (shown on the plots in Appendix E and Plate 1). A longer duration water level response plot for Monitoring Well MW101 shows that water levels essentially leveled out between Days 24 and 34, with no mechanism available to replenish the Aquifer any further (Figure 16). Following the period of maximum recovery, Aquifer-wide water levels were still approximately one foot lower than those at the start of pumping. After Day 34, the normal ambient decline of water levels in MW101 continued in response to the slow draining of the Aquifer.

For those wells outside of the Aquifer core (i.e., Response Type #2 wells), recovery was very sluggish or did not occur at all. In some cases, such as with Well DGD-M6, water level declines continued for approximately four days after the termination of pumping. As noted previously, the delay in water levels response within the Response Type #2 wells and the Response Type #1 wells reflects a significant contrast in the hydraulic conductivity (and transmissivity) of the fine and coarse sediments proximal to the two well types, respectively. As a result, water continued to drain slowly from the fine sediments into the unfilled cone of depression within the more transmissive sediments, even after pumping was terminated. The water levels in the fine and coarse sediments eventually equilibrated with each other and reached a water level that was, in some cases, the same as that which occurred within the fine sediments at the end of pumping (e.g., Well DGD-MW7).

The withdrawal of 8.4 million gallons of groundwater during the pumping test resulted in a general lowering of the entire Aquifer by approximately one foot. A portion of the 8.4 million gallons of groundwater came from storage within the Aquifer. Therefore, until recharge from precipitation replenishes the Aquifer, there is no mechanism to allow the groundwater levels to continue rising to a pre-pumping condition. ***The observed withdrawal of water from Aquifer storage response is not surprising, given that the pumping rate used for the pumping test was selected to deliberately exceed the sustainable capacity to the Aquifer in order to better evaluate the Aquifer response to large withdrawals for a portion of the year (i.e., peak fall water supply demand)***.

VII. CONCEPTUAL HYDROGEOLOGIC MODEL REFINEMENT AND DELINEATION OF THE WELLHEAD PROTECTION AREA (Env-Dw 302.17 and 302.18)

A. Conceptual Model of Groundwater Flow and Recharge Mechanisms

The results of the eight-day pumping test on Production Well DGD-PW2 support the original hydrogeologic conceptual model of the Aquifer, namely:

- The Aquifer can be pictured as a leaky bathtub (with a bedrock bottom and walls of Presumpscot clay) that is filled periodically with precipitation and that gradually drains by the flow of water through springs in less permeable deposits (under ambient conditions).

- Production Well DGD-PW2 is located within the "core" of the Aquifer, a highly permeable deposit that grades over relatively short distances into surrounding well-sorted, finer-grained sands.

- The extent of the Spruce Hole Aquifer is restricted in all directions. The ice-marginal marine delta that forms the Aquifer has defined boundaries of bedrock, till, or marine clay that restrict the movement of groundwater in and out of the Aquifer.

- The primary sinks for groundwater flow from the Aquifer are the Chesley Brook Springs, located just west of Packers Fall Road (Figure 10). A much smaller amount of groundwater flows in springs that feed small tributaries to the Oyster River and the upper Chesley Brook Watershed.

- The pumping of Production Well PW-2 does not lower water levels enough to induce recharge from any surface water bodies, so recharge to the Aquifer is restricted to that which infiltrates from precipitation.

- Locally, the unconsolidated Aquifer deposits are in direct hydraulic connection with the underlying bedrock fracture system, as witnessed by the clear pumping response seen in the Wong Domestic Well (Plate 1).

- Spruce Hole Bog is a perched wetland system fed by precipitation only and hydraulically independent of the underlying Aquifer. Excess recharge to the Spruce Hole Bog spills out of the Bog or leaks through the underlying wetland materials and then percolates downward into the Aquifer. *Lowering of the groundwater table beneath the Bog by pumping will have no impact on the rate of leakage from the Bog and will, therefore, not have an impact on the wetland system within the Bog.*

B. Corrections for Non-Pumping Water Level Variations

As mentioned earlier, groundwater level in the Spruce Hole Aquifer was gradually declining in the Aquifer prior to the pumping test. This ambient decline reflects the drainage of the Aquifer through springs and the loss of water from evapotranspiration. Because the rate of the pre-pumping ambient decline was essentially constant, a simple linear correction was applied to the water level data for each monitoring well. Therefore, where there was a pumping-induced water level impact, the trending ambient background water levels could be removed (Appendix F). The linear correction used for each well was determined using the specific water level data for each well. All reported pumping-induced water level drawdowns in this report were calculated using the corrected water level data (Table II).

Linear corrections often do not compensate for rain events. Although a large (3.32 inch) rain event during Day 7 of pumping caused major changes in water levels in the shallow piezometers and on flows within the River and tributaries, it had very little impact on water levels in the Aquifer. Therefore, there was no need to correct water level response plots for the monitoring wells to account for the rainfall. The lack of Aquifer response to the rainfall event is likely due to the significant soil moisture deficit created by dry conditions prior to the pumping test and the thick unsaturated zone above the water table.

C. Graphical Projection of Anticipated Water Level Drawdown and Delineation of the DGD-PW2 Zone of Influence

Potential impacts to the groundwater table in the area of Production Well DGD-PW2, under extended pumping conditions, were estimated by projecting the corrected water level drawdown observed during the pumping test to 180 days of continuous pumping at 725 gpm with no recharge. The estimated 180-day pumping-induced drawdown at each monitoring location was calculated by graphically extrapolating the pumping test data on logarithmic time versus drawdown plots (Figure 17, Table II, Appendix F). Projections were based on conservative extrapolations that resulted in more drawdown, rather than less. It is important to note that these projections are conservative in nature because actual pumping withdrawals will be limited to pumping 725 gpm for a maximum of 60 days per year.

Projections of the corrected pumping test data showed that the continuous pumping of Well DGD-PW2 for 180 days, at 725 gpm, would result in a water level drawdown of just 25.50 feet in the pumping well. This projected drawdown is equal to only 42% of the available drawdown in the Production Well.

Pumping-induced water level drawdown observed in the monitoring wells, that was related to the pumping of Production Well DGD-PW2 at 725 gpm for 180 consecutive days, ranged from 0.5 feet (in MW106) to 19.69 feet (in UNH-TW) (Table II). The largest projected water level impact in a domestic well (Wong Well) was 8.7 feet. The projected water level drawdown in the Wong Well will not impact the use of this domestic well. However, the projected impact on the Tsukrov Dug Well of 5.27 feet will likely utilize the available drawdown in the shallow well and jeopardize the ability of the Well to provide for domestic purposes.

In addition to the Wong and Tsukrov Wells, which both showed a clear response during the pumping test, EGGI also expects that, under long-term pumping conditions, minor water level impacts may occur in other water supply wells proximal to Well DGD-PW2, even if water level impacts were not measured during the pumping test (e.g., the Corrow, Dennen, and McDonough domestic wells) (Table II).

Potential water level impacts for 180 days of pumping at 725 gpm were also evaluated by creating a contour map of the projected water level drawdowns (Figure 18). This contour map shows the distribution of drawdown anticipated throughout the Spruce Hole Aquifer. In areas where no data existed or where there was no response during the pumping test, estimations of drawdown were made based on a plot of logarithmic distance versus drawdown after 180 days of pumping. This assessment indicates that potential water level drawdowns in the Corrow, McDonough, and Dennen bedrock wells would be less than approximately five feet after 180 days of pumping Well DGD-PW2 at 725 gpm.

The estimated line of zero drawdown on Figure 18 defines the 180-day Zone of Influence (ZOI) around Production Well DGD-PW2. The ZOI incorporates an area of approximately 230 acres.

D. Calculation of Aquifer Coefficients Using Analytical Methods

Analytical modeling of the pumping test data for those wells in which pumping-induced water level impacts occurred during the pumping test was conducted using AquiferTest Pro Version 4.0 software (Table V and Appendix G). The water level response that occurred in 14 of the 15 impacted wells was consistent with the Neuman (1975) analytical model for “delayed yield from storage”. This model indicates that recharge to the well was delayed during the early portion of the pumping interval because vertical heterogeneities in the Aquifer (such as layering in the material) delayed gravity drainage of recharge water downward through the Aquifer.

Eleven of the 15 impacted wells required the addition of a “barrier boundary” that simulates the impact caused by the cone of depression intercepting an impermeable formation bordering the Aquifer. In general, a barrier boundary makes the drawdown increase beyond what would be expected if the barrier boundary did not exist. This is consistent with our conceptual understanding of the Spruce Hole Aquifer being limited in extent and surrounded with lower permeability material.

Only one well, Tsukrov, could not be modeled using the Neuman analytical model. The water level response in the Tsukrov Well fit the Theis analytical model, which doesn't account for the effect of vertical heterogeneities and delayed yield (Theis 1935). The Tsukrov Well response also may have been difficult to model because of the large volume of storage in this 4-foot-diameter, cement tiled, well.

Aquifer coefficients, including transmissivity, specific yield, ratio of vertical to horizontal hydraulic conductivity, and whether a barrier boundary was required in the model are included in Table V. The modeling results are subdivided into the two distinct groups defined previously on each well's response to pumping, as follows: Response Type #1 Wells (in the core of the Aquifer) and Response Type #2 Wells (in the finer sands surrounding the core). As seen in Table V, Response Type #1 Wells had higher transmissivities (averaging 21,314 ft^2/day) than Response Type #2 Wells (averaging 6,975 ft^2/day). Response Type #1 Wells also had lower specific yields (0.05) vs. Response Type #2 Wells (0.17), and smaller ratios of vertical to horizontal hydraulic conductivities (0.03 vs. 0.18).

A plot of logarithmic distance versus drawdown at the end of pumping was created to further evaluate the hydrologic properties of the Spruce Hole Aquifer (Figure 19). A best-fit line drawn through the data points highlights two items of interest:

1) Production Well DGD-PW2 is very efficient (approximately 97%), meaning that there is a very good hydraulic connection between the Aquifer and the Well. High efficiency wells translate into lower pumping energy costs (due to less drawdown) and a reduced need for regular maintenance.

2) The best-fit line bisects those data points that were earlier separated into Response Types #1 and #2. Those data points that fall below the line are Response Type #1 (with the exception of MW102) and those that lie above the line are Response Type #2.

The distance vs. drawdown plot was also used to calculate Aquifer coefficients using the Jacob Modified Non-Equilibrium Well Equation. This method indicates that the "bulk" transmissivity and specific yield of the Aquifer are 10,420 ft^2/day and 0.06, respectively. These results are within the range of the hydraulic values determined using the analytical models described above.

E. Numerical Modeling of the Spruce Hole Aquifer

1) Intended Purpose of Modeling

Numerical models of groundwater flow provide a means to mathematically simulate the flow of groundwater into, through, and out of an aquifer. A properly constructed and calibrated numerical model allows the testing of a wide variety of boundary conditions (i.e., sources of recharge or impermeable barriers to groundwater flow, etc.) in order to e evaluate which combination of specific hydraulic conditions produces similar pumping-induced responses to those observed during a pumping test. Therefore, the power of a numerical model is that it

allows many hypotheses of groundwater flow to be tested and revised, such that the conceptual model of groundwater flow in an aquifer can be developed in much greater detail than with analytical modeling alone. Once a numerical simulation more accurately represents conditions actually observed, it can be used to simulate various pumping scenarios and climatic conditions. This ability to simulate (project) pumping-induced impacts out in time and under different ambient conditions allows the development of effective strategies for managing groundwater withdrawals from an aquifer.

Given the extent and quality of the dataset generated during the extended non-pumping interval and the eight-day pumping program, it was determined that a numerical model would be a valuable asset in helping to address the following questions about the Spruce Hole Aquifer, including:

- What is the maximum yield and long-term sustainable yield of Production Well DWP-PW2?
- How will withdrawals from Production Well DWP-PW2 be managed to minimize impacts on the Chesley Brook Springs and the Spruce Hole Bog?
- What potential impacts will the pumping of Production Well DGD-PW2 have on existing water resources within and proximal to the Spruce Hole Aquifer?
- Is the Spruce Hole Aquifer a feasible location for the implementation of an Artificial Recharge program that would withdraw surface water from the Lamprey River during periods of relatively high stream flow and store it in the Aquifer for later use?

2) Background to Modeling

The two-dimensional numerical model created during this study was a collaborative effort between EGGI and J. Matthew Davis & Associates, LLC. (MDA). The groundwater modeling was conducted using MODFLOW-SURFACT v.3 software by HGL Software Systems, Inc. (Harbaugh and McDonald 1996; Harbaugh et al., 2000; Pollock, 1994, Environmental Simulations, Inc., 2007). Groundwater Vistas (Environmental Simulations, Inc.) was used as a graphical interface for the modeling program.

The aerial extent of the numerical model domain incorporates all of the Spruce Hole Aquifer (Figure 20). Details of the modeling methods utilized are summarized in MDA's report in Appendix H. The major components and datasets that formed the basis for the modeling are represented graphically on Plate 3, Views A-L.

The construction, calibration, and application of the numerical groundwater flow model of the Spruce Hole Aquifer incorporated the following six steps:

1) *Construction of the Numerical Model* – The numerical model was constructed to simulate the conceptual model of groundwater flow in the area. The conceptual model evolved as data was gathered from previous investigations, the interpretation of geophysical surveys, data collected from monitoring

wells installed and tested, water levels monitored, etc. The conceptual model was first used to define the geometry of the Aquifer, discretizing the model into 284,466 active cells (118 rows, 100 columns, and three layers) and applying fundamental hydraulic characteristics to each node (Plate 3, Views A-G);

2) *Applying Boundary Conditions to the Model* -- The boundary conditions of the numerical model allow water to enter and leave the model (i.e., recharge via precipitation, flow to springs, flow to streams, etc.) (Plate 3, View C).

3) *Calibration of the Numerical Model* -- During the calibration process, sequential changes are made to different model characteristics and boundary conditions, such that model simulations of groundwater elevations and/or fluxes approximate those actually observed during the extended non-pumping period prior to pumping and during the pumping test (Plate 3, Views H-L). The numerical model was calibrated to two datasets -- the 2010 pre-pumping and pumping test data and the 1994-1998 water level data collected by Ballestero and Lee (2000). The final calibrated numerical model is capable of closely simulating the actual change in Aquifer water levels due to both non-pumping and pumping events (see Plate 3).

4) *Pumping Simulation #1* -- Pumping Production Well DGD-PW2 at 725 gpm for 60 days per year (September and October) with no pumping for the rest of the year. Scenario continued for 10 years;

5) *Pumping Simulation #2* -- Pumping Production Well DGD-PW2 at 120 gpm for 365 days. Scenario continued for 10 years;

6) *Pumping Simulation #3* -- Pumping Production Well DGD-PW2 at 725 gpm for 180 days with no recharge.

The Aquifer response during each scenario is graphically presented on Plate 4. Insights gained from these modeling simulations are presented below and on Plate 4.

3) Results of Simulations #1 and #2

One of the main thrusts for the development of Production Well DWP-PW2 was to supply additional water resources to the UNH/Durham Water System during the months of September and October, a period when peak water demand corresponds to the lowest flows in the Lamprey River.

Pumping Simulation #1 was performed to determine how many days Production Well DWP-PW2 can be pumped at 725 gpm on a sustainable basis (i.e., when annual groundwater recharge will replace the amount of groundwater withdrawn). As shown on Plate 4, a numerical simulation of pumping 725 gpm for 60 days per year demonstrates that, after a few years, water levels in the Aquifer and fluxes to streams *stabilize*, suggesting that an annual withdrawal of 63

million gallons is sustainable (Plate 4, View D). A contour map of groundwater elevations after ten years of withdrawals at 725 gpm for 60 days is shown in View D of Plate 4.

Pumping Simulation #2 was created to evaluate potential impacts from withdrawing a total of 63 million gallons over a 365-day period, (i.e., at constant rate of 120 gpm throughout the year). The results of Simulation #2 indicate that pumping Production Well DEP-PW2 year-round at a pumping rate of 120 gpm would result in similar pumping-induced effects on water level elevations and fluxes into and out of the Aquifer as those observed in Simulation #1 (Plate 4, View D).

The similar Aquifer response to pumping 725 gpm for 60 days per year or 120 gpm for 365 days per year results from the fact that the Spruce Hole Aquifer acts somewhat like a storage tank or reservoir. It has a large, but finite, reserve of groundwater in storage and the sediments are transmissive enough that it that can be tapped for high volume, short-term extractions. Annual withdrawals are limited to a total of approximately 63 million gallons per year by the available recharge (via precipitation) to the Aquifer. Larger annual extractions will result in the long-term mining of the groundwater and a permanent lowering of groundwater elevations within the Aquifer, unless some form of Artificial Recharge is added to the Aquifer.

4) Results of Pumping Simulation #3 -- Pumping at 725 gpm for 180 Days with no Recharge

In order to establish the Wellhead Protection Area (WHPA) around Production Well DGD-PW2, a simulation was performed that included withdrawals at 725 gpm for 180 days. This is three times the withdrawal volume that we would expect during a year, but it was done to simulate a severe stress on the Aquifer that would result in the most conservative WHPA.

The modeling shows that the contributing area at the end of the 180-day pumping period was very similar in lateral extent to that which would occur after the 60-day, 725-gpm pumping interval. This occurs because the relatively impermeable bedrock, till, fine sand, and clay surrounding the Aquifer limit the lateral expansion of the cone of depression under both pumping scenarios. The larger volume of water required during the 180 days of pumping is obtained from storage within the Aquifer, resulting in the additional lowering of the water level within the core Aquifer itself.

The resultant groundwater elevation contour maps from both Layers #1 and #2 are shown on Plate 4, View C, as are six representative plots of actual and estimated groundwater elevations versus time. The configurations of the groundwater table generated by the numerical model are similar to those determined during graphical projection of water level drawdowns. Therefore, the results of graphical projection of pumping test response data were used to define the WHPA boundaries (discussed below in Section VII, F).

5) Model Limitations

The numerical model of the Spruce Hole Aquifer was created using hydrogeologic insights provided by previous investigations, through the installation of monitoring wells, and

water level data collected during an extended non-pumping period and the eight-day pumping test. The conceptual model created from these datasets formed the basis for the numerical model construction and calibration.

Although the results of the numerical model simulations generally successful at reproduced hydrogeologic conditions within the Spruce Hole Aquifer, the complex hydrogeologic setting of the Spruce Hole Aquifer imparts certain limitations to the application of the model.

- Modeling of water levels within the Spruce Hole Aquifer is based on water level responses observed solely during the investigation. The projection of water level responses at significantly lower or higher groundwater elevations may be subject to increasing errors the more simulated conditions vary from those actually measured. Verification of the numerical model under different hydrogeologic conditions would provide a higher level of confidence that the numerical simulation can be applied to a wider range of Aquifer conditions.
- The modeling of the interaction between groundwater and surface water bodies, such as Chesley Brook, poses unique hydraulic conditions that are difficult to model. Therefore, modeled interaction between groundwater and surface water, while providing useful guidance on bulk responses, may not accurately simulate flows at any specific location along the stream.
- Drains included in the numerical model represent a generalization of the actual groundwater flow from the Spruce Hole Aquifer. Therefore, pumping-induced impacts to flow from specific springs cannot be predicted using this model.

F. Delineation of the DGD-PW2 Wellhead Protection Area and Potential Impact Area

The final Wellhead Protection Area (WHPA) around Production Well DGD-PW2 encompasses an area of approximately 102 acres (Figure 21). The WHPA was delineated by subtracting the 180-day projected drawdown contours from the pre-pumping groundwater elevation contours. The resultant 180-day projected groundwater elevation contour map was used to define the Zone of Contribution to the Production Well (Figure 21). The groundwater elevation contour map was used to define the divide between groundwater that flows towards the established cone of depression from that groundwater which flows away from it. The size of the Final WHPA is only 44% of the area within the Zone of Influence, which shows that Production Well DGD-PW2 can only divert groundwater flow lines in a relatively small portion of the area that it can influence by pumping. The relatively small size of the WHPA is favorable from a protection standpoint, as it will be much easier to control and track land uses within the smaller area. However, the limited size of the WHPA also restricts the sustainable capacity of the Production Well because recharge to the Well is limited to precipitation over that small area, unless some form of Artificial Recharge is made available.

The Final Potential Impact Area (PIA) will remain unchanged from that which was defined in the Preliminary Report, a total area of 6.9 square miles (Figure 22). The PIA incorporates the lower portions of the Oyster River Watershed from its discharge into the Great Bay Estuary, to a point just upstream of the bridge on the Old Concord Turnpike in Durham (near the USGS Gaging Station, approximately 5,500 feet up gradient of the confluence between the Oyster River and Chesley Brook).

G. Water Budget Calculations

1) General Water Budget Considerations

The New Hampshire Department of Environmental Services (NHDES) provided basic data regarding the groundwater and surface water budget of the Oyster River Watershed as part of its recharge and low-flow estimates (Appendix I). The entire Spruce Hole Aquifer lies within the 19.78 square mile watershed of the Oyster River. The total area of the Chesley Brook Watershed is 912 acres (1.43 square miles).

The NHDES estimates that, during an average year, the Oyster River Watershed receives 42.99 inches of precipitation and that the average groundwater recharge within the Watershed is approximately 20.1 inches per year. Therefore, approximately 23 inches of precipitation (about 54%) is lost to evapotranspiration and quick flow.

Total discharge at the mouth of the Oyster River at the start of the pumping test was estimated as follows:

- The gaged flow in the Oyster River was 0.71 cfs or 318 gpm from the 12.1 mi^2 Watershed above the gage.
- The ratio between the total area of the Oyster River Watershed minus that of Chesley Brook (19.78 mi^2 – 1.43 mi^2 = 18.35 mi^2) and that upgradient of the USGS gaging station is equal to 1.52.
- Therefore, flow at the mouth of the Oyster River from the Watershed excluding Chesley Brook is estimated to have been 1.08 cfs or 483 gpm.
- Flow in Chesley Brook was approximately 0.89 cfs or 400 gpm at the same time.
- Therefore, total flow at the mouth of the Oyster River at the start of pumping is estimated to have been 1.97 cfs or 884 gpm.

The flow recorded at the gage is equal to the summertime Q83 flow within the Oyster River (i.e., the flow equaled or exceeded about 83% of the time; Appendix I). If the Q83 flow characteristics in the Chesley River Watershed were similar to those in the Oyster River Watershed, the flow in Chesley Brook (new Station DGD-SW4) at the beginning of the pumping test, under Q83 conditions, should have been approximately 38 gpm.

The fact that a base flow of approximately 400 gpm was measured during the pre-pumping and pumping portions of the testing program suggests that the recharge characteristics

within the Chesley Brook Watershed are significantly different that those in the Oyster River Watershed. This difference is likely due to the dominance of spring flow as a source of recharge to Chesley Brook.

2) Water Budget in the Chesley Brook Watershed

Field observations conducted at the start of this investigation indicated that the flow in Chesley Brook was due in large part to springs emanating from glacial deltaic deposits. These deposits are located north and south of Chesley Brook in the area west of Packers Falls Road (Figures 3 and 10). A small component of base flow in Chesley Brook is derived from the portion of the Watershed underlain by the Presumpscot Formation and till.

As noted previously, it is estimated that approximately 124 acres of the Spruce Hole Aquifer drains into the Chesley Brook Springs (Figure 10). In addition, springs on the north side of Chesley Brook, are likely fed from groundwater flowing out of approximately 64 acres of the marine delta deposit north of Chesley Brook (herein called the Northern Aquifer). Therefore, a total of approximately 188 acres of Aquifer deposits drain into the Chesley Brook springs. The remaining 724 acres of the Chesley Brook Watershed are underlain by "non-Aquifer" materials that comprise the Presumpscot Formation and till.

As noted previously, a recharge rate of 20 to 27 inches within the Spruce Hole Aquifer would contribute 128 to 173 gpm to the base flow within Chesley Brook, or 30% to 40% of the total 400 gpm base flow measured prior to the start of the pumping test. The following also shed light on the various groundwater contributions to base flow within Chesley Brook:

- Surface Water Station DGD-SW2 monitored a portion of the Watershed that drains areas underlain by relatively impermeable, "non-Aquifer" materials that comprise till and the Presumpscot Formation. Flow at this Station was only 25 gpm during the pumping test (Plate 2). Because this Station represents flow from 25% of the portion of the Chesley Brook Watershed underlain by "non-Aquifer" materials, it is reasonable to estimate that the portion of the watershed underlain by till and the Presumpscot Formation contributes approximately 100 gpm to the base flow of Chesley Brook.

- Therefore, the areas of the Chesley Brook Watershed that are underlain by the glacial marine deposits/aquifers contribute approximately 300 gpm of 400 gpm base flow in Chesley Brook. Based on the relative size of the two deltaic aquifers within the Chesley Brook Watershed, the base flow contributions from the Spruce Hole and Northern deltaic aquifers are estimated to be 200 and 100 gpm, respectively.

- An average annual discharge of 200 gpm from an area of 124 acres would require a groundwater recharge rate of 31.2 inches annually. That is higher than the 18 to 24 inches of recharge estimated for most watersheds underlain by glacial deposits in New Hampshire. This high recharge rate may be just an

anomaly for this specific location or it could be the result of some uncertainty in the size of the groundwater watershed contributing to the Springs on the north side of Chesley Brook.

3) Sustainability of Groundwater Withdrawals

The long-term sustainable yield of Well DGD-PW2 was determined based on the average amount of precipitation that falls within the Zone of Contribution (i.e., the Wellhead Protection Area) around the Well. As noted previously, the designated WHPA around Production Well DGD-PW2 includes an area of approximately 102 acres. EGGI's water budget evaluation suggests that the recharge rate for the contributing area to the Springs is 31.2 inches per year. As this recharge rate is on the high end of those generally estimated for stratified drift aquifers in New Hampshire, EGGI considers that a rate of 24 inches per year to be a reasonable conservative estimation of groundwater recharge within the DGD-PW2 WHPA. This amount of recharge would provide a sustainable capacity of 126 gpm, 182,000 gpd, or 63 million gallons per year (mpy).

It is clear from the pumping test results that the Spruce Hole Aquifer contains large volumes of groundwater in storage that can be effectively tapped on a short-term basis at high pumping rates or pumped at lower rates for longer durations. Recovery of water levels in either case occurs slowly as natural recharge balances the withdrawals.

The UNH/Durham Water System is in need of large volumes of groundwater during the fall when the University System is populated with students. These high water supply demands can be met by withdrawing 725 gpm (1,044,000 gpd) of groundwater from Well DGD-PW2 for 60 days of the year, or a total withdrawal of 63 million gallons. Under this pumping scenario, the groundwater in storage will provide water to meet System demands without needing to withdraw excessive volumes of water from the Lamprey River during times of the year when that River has its lowest flows (and is presumably most stressed).

Based on the conservative estimates of sustainable groundwater withdrawals and the needs of the UNH/Durham Water System, a two-tier structure of the permitted production volume (PPV) was devised. The first tier satisfies the need for short-term withdrawals at a high-yield (725 gpm for 60 days or 63 million gallons per year followed by ten months when the Well is not pumped). The second tier allows for the Well to be utilized at a sustainable rate of 120 gpm, year-round, which also provides about 63 million gallons per year. Because of the nature of the Spruce Hole Aquifer, it doesn't matter when the groundwater is removed during the year, as long as the annual withdrawal volume does not exceed 63 million gallons. Therefore, EGGI recommends that the two tiers of the PPV provide the ends of a continuum that provide for total annual withdrawals of up to 63 million gallons, with the daily withdrawal never exceeding 1,044,000 gallons. ***However, please note that these amounts of groundwater could be increased if sources of Artificial Recharge were provided to this Aquifer.***

VIII. WATER QUALITY (Env-Dw 302.12)

A. Water Quality Sampling Procedure

During the testing program, a variety of groundwater samples were collected from the Production Well DGD-PW2 to determine the quality of water being withdrawn. In accordance with NHDES regulations, samples were collected on the first, third, and final day of the pumping test for a prescribed list of parameters (Table VI and Appendix J). Duplicate samples collected on Days 2 and 8 of the pumping test were also collected and analyzed. In addition, field chemistry[3] was recorded in the discharge water once per day during the pumping period and, also, one time at each of the surface water monitoring stations (Table VII).

B. Results of Water Quality Sampling Program Conducted During the Eight-Day Pumping Test

The results of all water chemistry analyses indicate that the water from Production Well DGD-PW2 is of excellent quality and meets all Primary and Secondary drinking water standards for potable water supply wells. Water withdrawn from the Well will not require treatment to serve the potable water needs of the UNH/Durham Water System[4] (Table VI). In addition to the chemistry samples, bacteriological tests also showed the samples were free of Total Coliform and E. Coliform bacteria.

All of the radiological parameters were *below* EPA Drinking Water Standards (Table VI). Radon level in the groundwater sampled from Well DGD-PW2 was 3,866 picoCuries per liter (pCi/L) during the pumping test (Table VI). These concentrations are slightly above the 2,000 pCi/L NHDES recommended maximum contaminant level for radon. However, they are lower than the proposed EPA regulations that will prohibit concentrations of above 4,000 picoCuries in public water supplies[5].

VOCs and SOCs were *not* detected in groundwater samples obtained from Well DGD-PW2 during the testing program (Table VI). Perchlorate, iron and manganese concentrations were all below laboratory detection limits within the groundwater (Table VI).

Field water quality analyses of water collected from Production Well DGD-PW2 during the pumping test did not show any meaningful trends in transient water quality (Table VII). Very low levels (<0.05 mg/l) of iron were detected in several of the water samples collected from Well DGD-PW2.

The transient water quality data collected during the pumping program did highlight chemical contrasts between the surface water and groundwater (Table VII). Significantly higher concentrations of iron (0.12 to 0.5 mg/l) were present in the samples from the tributaries at

[3] Field chemistry parameters included temperature, pH, redox, dissolved oxygen, conductivity, and iron.
[4] Treatment related to the transmission of the water through the distribution system may be required (e.g., chlorination).
[5] The NHDES and the EPA do not currently have approved maximum contaminant levels for radon.

Stations DGD-SW3, DGD-SW4, and DGD-SW5. In addition, the specific conductivity of water samples collected from Stations DGD-SW2, DGD-SW4 and DGD-SW5 were substantially higher than the DGD-PW2 well water (Table VII).

The field chemistry results also showed that the Spruce Hole Bog (SW-1) has dramatically different chemistry from both the DGD-PW2 well water samples ***and*** the surface water tributaries draining the Spruce Hole Aquifer. This contrast is to be expected from a relatively stagnant water body that is perched above the underlying Aquifer.

IX. CONTAMINATION SOURCE AND WATER RESOURCE AND USE INVENTORY UPDATE (Env-Dw 302.19)

EGGI reviewed the contaminant threat databases available through the NHDES on April 3, 2012, and found no additions since the Preliminary Application was submitted within the newly designated WHPA of Production Well DGD-PW2 (Figure 23). The only land uses of any concern are the operation of the Durham Town Pit where the Well is located and a few domestic septic disposal systems that are located approximately 500 feet, or more, from the Production Well.

Gravel mining and stockpiling of material may continue on the site until the Production Well is put on-line. However, the Town is prepared to terminate all operations within the pit once the Well is being used as a public water supply source.

X. CONTAMINATION CONTROL PROGRAM FOR EXISTING CONTAMINATION (Env-Dw 302.20)

There are no known sources of contamination within the designated WHPA around Production Well DGD-PW2.

XI. POTENTIAL IMPACTS TO EXISTING WATER RESOURCES FROM PUMPING PRODUCTION WELL DGD-PW2 (Env-Wq 403.17)

A. Potential Public and Private Water Use Impacts

1) Potential Impacts to Public Water Supplies

Two public water supplies were monitored during the pumping test program -- Packers Falls Village and the Inn at Spruce Woods (Figure 8 and Table II). Water levels measured in these public supply bedrock wells were not impacted during the pumping test.

The long-term use of Production Well DGD-PW2 is not expected to have any impact on the utilization of the existing bedrock Public Supply Wells to provide potable water to their customers. An extrapolation of pumping-induced water level impacts within the Aquifer using the 180-day distance-drawdown plot suggests that a water level drawdown of approximately 2.1 feet could potentially occur in the Packers Falls Village Well, ***if*** Well DGD-PW2 were ever

pumped 180 days at 725 gpm (Table II). (Note that the PPV limits pumping at 725 gpm to 60 days.) Such limited drawdown will not create an adverse impact to the use of this Well.

2) Potential Impacts to Private Domestic Wells

The Tsukrov Well is the only domestic well where long-term pumping from Production Well DGD-PW2 is expected to interfere with the normal domestic use of the Tsukrov Well (Table II). Because this shallow dug Well is only 15.4 feet deep (below the top of the cement tiles) and the pre-pumping water table was 10.13 feet, there is limited available drawdown in the Well (i.e., 5.27 feet). Because the pump intake is 14.5 feet deep, the available drawdown at the start of the pumping test was 4.4 feet. Projected drawdown after 180 days of pumping at 725 gpm is 5.27 feet, so this Well would be unable to serve the domestic needs of the Tsukrov home. Of course, the recommended PPV will not allow such an extreme pumping event to take place, but 3.87 feet of pumping-induced water level drawdown could occur in the Well even after 60 days of continuous pumping. Depending on the starting water level in the Well, this amount of drawdown could disrupt its use. Therefore, a mitigation plan will need to be designed to allow for uninterrupted use of a domestic supply well at this location or to provide well replacement.

All the other monitored domestic wells and bedrock wells are projected to have less than ten feet of interference drawdown. It is very unlikely that this amount of pumping-induced water level drawdown will impact the use of these bedrock water supply wells.

B. Potential Impacts to Local Wetlands, Chesley Brook, and the Oyster River

1) Anticipated Impact in Spruce Hole Bog and Other Wetlands

The Spruce Hole Bog has been shown to be a wetland system that is hydraulically independent of the underlying groundwater table. The numerical simulations corroborate our observations that the Spruce Hole Bog exists independent of the underlying groundwater table and extended pumping should have no noticeable impact on the hydrologic regime of that wetland system. The surface water/shallow groundwater system of the Bog is perched approximately 12 feet above the groundwater table. The base of the Bog has a very low permeability due to the presence of fine-grained glacial deposits and thick peat. Excessive precipitation onto the Bog surface may result in water leaking out (overflow) of the Bog along the edges. Because the Bog is hydraulically perched above the underlying groundwater Aquifer, the lowering of the groundwater table in response to the long term pumping of Well DGD-PW2 is not expected to have any impact on the water budget of the Bog.

Two other kettle holes with wetlands exist to the east and west of DGD-M7 (Figure 6). Clay and organic material were observed in the shallow (<1 foot) subsurface of the western wetland during the installation of Piezometer DWP-P4. As with the Spruce Hole Bog, it is anticipated that the wetlands are hydraulically perched above the underlying groundwater Aquifer.

Wetlands along the small streams draining north and northeast of the Production Well, in the vicinity of Piezometers P3 and P5, may have *indirect* hydraulic connections with the Spruce Hole Aquifer. Flow within the streams is likely supported, in small part, by spring flow from the northern portion of the Spruce Hole Aquifer. However, the majority of water to these streams and wetlands will enter as direct precipitation within the contributing watershed to the streams. Pumping of Production Well DGD-PW2 is anticipated to have a negligible impact on these wetlands by reducing flow from the contributing springs.

The wetlands at, and downgradient of, the Chesley Brook Springs will potentially be impacted by pumping-induced reductions in flow from the Springs. Although the long-term pumping of Well DGD-PW2 will reduce the volume of groundwater entering Chesley Brook, and thus the adjacent wetlands, it is unknown whether the decrease in groundwater discharge would significantly alter the functions and values of those wetlands.

2) Anticipated Impact on Flow from Chesley Brook Springs

Groundwater discharge to the Chesley Brook Springs will be reduced under any pumping conditions as the total volume of groundwater draining from the Aquifer is reduced. However, the geometry of the underlying Aquifer is such that a hydraulic gradient will always be maintained that allows flow towards the springs. In other words, there is no way that the pumping of Production Well PW-2 will induce spring water back into the groundwater system. The numerical model does show that a small portion of Chesley Brook west of Production Well DGD-PW2 can lose water to the Aquifer under extended pumping conditions. However, it is believed that this occurrence is an artifact of the model construction and, in reality, such leakage cannot occur due to the large thickness of marine clay underlying Chesley Brook at that location. Therefore, any reductions to flow in Chesley Brook will be from the diversion of groundwater flow lines to the Production Well that prevent their natural discharge into the Brook or springs.

In the Water Budget discussion earlier, it was argued that total spring flow from the Spruce Hole Aquifer into Chesley Brook from Chesley Brook Springs is approximately 200 gpm, or approximately 50% of the base flow observed at the start of the pumping test program. Assuming that that rate of flow continues year-round, the total spring discharge into Chesley Brook from the south is approximately 105 million gallons per year.

Two methods were used for estimating potential pumping-induced decreases in spring flow along the south shore of Chesley Brook.

The first gross means of quantifying the potential impact of pumping on spring flow is based on the size of the contributing watershed to the Springs. Based on our calculations, the capture zone of the Production Well will divert groundwater recharge from 85 acres of the 124-acre contributing area to the Springs (or 69%). Therefore, under long-term pumping conditions, spring flow might be expected to decline to approximately 31% of the base flow from the Spring. However, the WHPA area that is applied in these calculations is based on a conservative estimation of the WHPA size that may make it larger than will be seen in actuality (the WHPA area was based on projecting the impact of a 725 gpm withdrawal for 180 days).

The second means of estimating the potential impact of pumping on spring flow along Chesley Brook is based on the requested Permitted Production Volume (PPV) for Production Well DGD-PW2 and the percent of that volume that must come from the contributing area to the Springs. The following steps were used for this estimate.

- The requested PPV would result in annual withdrawals of 63 million gallons from the Spruce Hole Aquifer.
- 85 acres of the 102-acre WHPA overlaps with the contributing area to the Chesley Brook Springs; therefore,
- 83% (85 acres divided by 102 acres) of the recharge to the Production Well comes from groundwater that would be discharging to Chesley Brook;
- 83% of 63 million gallons per year withdrawals is equal to 52 million gallons of water that is being diverted from the Springs annually or 50% of flow to the Springs.

Therefore, it is anticipated that unmitigated withdrawals from Production Well DGD-PW2 will reduce annual groundwater discharge to the Chesley Brook Springs by between 50 and 69% (or 100-138 gpm). Long-term monitoring of the area will be required to assess the real impacts and which mitigation measures would be best.

3) Anticipated Pumping Impacts in Chesley Brook and the Oyster River

Long-term withdrawals from Production Well DGD-PW2 will have an impact to flow in Chesley Brook and the Oyster River by diverting groundwater flow lines that are migrating towards the Chesley Brook Springs towards the pumping well, thereby reducing spring flow into Chesley Brook (from the Spruce Hole Aquifer).

As mentioned in the Water Budget section above, base flow contributions to Chesley Brook equal 400 gpm, half of which is be contributed by springs emanating from the Spruce Hole Aquifer. If spring flow from this Aquifer is reduced by 50% during the long-term pumping of Well DGD-PW2, then the total base flow of Chesley Brook will be reduced to 300 gpm (100 gpm from non-Aquifer areas, 100 gpm from the Aquifer to the north, and 100 gpm from the Spruce Hole Aquifer). Therefore, it is likely that a 25% reduction in base flow will occur within Chesley Brook downgradient of the springs, which are located approximately 1,000 feet upgradient of the Oyster River.

Direct losses of flow to the Oyster River due to pumping-induced flow reductions in the contributing tributaries draining north and northeast from the Aquifer (where P-3 and P-5 are located) will be negligible. As discussed earlier, most of the flow to these tributaries is from direct precipitation in their respective watersheds that cannot penetrate to the deeper Aquifer due to the presence of low-permeability marine deposits. Aquifer contributions directly to the Oyster River likely occur only in wet periods when the Aquifer is high enough to spill over the clay and migrate towards the tributaries.

The only significant reduction in Oyster River flow due to pumping will occur via losses of spring flow to Chesley Brook. During most times of year, the large size of the Oyster River Watershed (compared to that of Chesley Brook) will make the reduction in flow from Chesley Brook negligible.

XII. WATER CONSERVATION PLAN FOR THE TOWN OF DURHAM (Env-Wq 2101)

The UNH/Durham Water System is in the process of preparing a Water Conservation Plan to be submitted to NHDES, in accordance with Env-Wq 2101. That document will be submitted by the Water System independent of this document. It is understood that final approval of Production Well DGD-PW2 as a Public Supply Well will be contingent upon approval of the Water Conservation Plan by NHDES.

XIII. RECOMMENDATIONS FOR PERMANENT PRODUCTION OF GROUNDWATER FROM PROPOSED PRODUCTION WELL DGD-PW2 (Env-Dw 302.16)

A. Recommendations for Groundwater Withdrawals from Production Well DGD-PW2

EGGI recommends that proposed Production Well DGD-PW2 be approved for the withdrawal of 63 million gallons of groundwater per year. The actual operation of the Well will be performed between the two following end members:

1) *Permitted Production Volume (PPV) for year-round use:* The recommended year-round, 24 hours per day withdrawal rate is 172,800 gpd (120 gpm); and.
2) *Peak Demand Production:* A pumping rate of 725 gpm (d1,044,000 gpd) could also be accomplished for a maximum duration of 60 days per year.

The most urgent needs of the UNH/Durham Water System include an alternative source of water that can supply high yields during late August through late October when the UNH/Durham Water System withdrawals from the Lamprey River are typically restricted by low flows within the River (late August through late October). A PPV of 1,044,000 gpd (725 gpm) for 60 days would allow the UNH/Durham Water System to meet high demand while, at the same time, reduce or eliminate the need for the UNH/Durham Water System to make withdrawals from the Lamprey River for a period of 60 days. However, the UNH/Durham Water System would like to maintain flexibility in the operation of the Well, such that it could be used to supplement other UNH/Durham Water System water supply sources while they are temporarily off-line or during periods of unusually high demand (i.e., fire flow). To maintain maximum flexibility in the use of this Well, the PPV for year-round use and the conditional PPV for high-yielding, shorter-term pumping should be considered as *"end members"* of a pumping scheme that has an *annual* limitation of 63 million gallons of groundwater withdrawals from Production Well DGD-PW2.

B. Mitigation of Impacts from Pumping Production Well DGD-PW2

Regardless of the distribution of withdrawals throughout the year, the removal of 63 million gallons of groundwater from storage is expected to produce impacts to several water resources noted below:

- **The Tsukrov Domestic Well:** This Well is a shallow dug well that will likely be adversely impacted by the long-term pumping of Production Well DGD-PW2, such that it will be unable to supply the home with dependable potable water. Numerical model projections and graphical projections of pumping test responses show that the Tsukrov Domestic Well will be substantially impacted under any of the proposed pumping scenarios and that a mitigation plan will need to be developed to provide for domestic water uses at that home. Therefore, a mitigation strategy will have to be employed to provide the Tsukrov home with a reliable source of potable water. Mitigation strategies could include:

    - Deepen the existing dug well;
    - Replace the existing shallow dug well with a deep bedrock well; or
    - Connect the house to the UNH/Durham Water System. No discussions have taken place to date with the Tsukrovs with regard to providing a replacement supply.

- **Chesley Brook Springs along the south bank of Chesley Brook (the natural sink for groundwater flow from much of the Aquifer):** The pumping of Production Well DGD-PW2 will decrease the volume of spring flow at this location, but the potential impact of the decreased volume is unknown. Groundwater continuing to flow from the Springs may be adequate to maintain the flora and fauna within the narrow strip of wetlands on the south shore of Chesley Brook. A wetlands assessment by a certified wetland scientist will have to be conducted to evaluate the potential for decreased spring flow to adversely affect the functions and values of those wetlands. In addition, a long-term monitoring plan for the wetlands will need to be established that will help to further understand what impacts could occur.

- **Chesley Brook Flow:** The flow of Chesley Brook is anticipated to be slightly to moderately reduced by withdrawing groundwater from the Spruce Hole Aquifer. Although the decrease in groundwater discharge is expected to be less than 25% of the base flow, the impact of decreased flow volume on existing species of flora and fauna is unknown. Chesley Brook serves as a habitat for the American Brook Lamprey, an endangered species listed by the Natural Heritage Bureau in New Hampshire (Appendix K). A long-term evaluation of the flow of Chesley Brook, with regard to assessing the possible impact of decreased flow from the Springs draining the Spruce Hole Aquifer,

may need to be performed to determine if a mitigation plan is necessary or if the implementation of a long-term monitoring program is desirable.

- **Neighboring domestic wells:** Although all the nearby homes that might be impacted by pumping were notified with an offer to monitor water levels during the pumping test, several homes declined the invitation and nothing is known about the wells that serve those homes. If other dug wells exist within the area of significant water level decline, they may also require mitigative action.

The UNH/Durham Water System has submitted a Groundwater Discharge Permit application to the NHDES for the use of Artificial Recharge (AR) to the Spruce Hole Aquifer to supplement natural recharge with water withdrawn from the Lamprey River. The use of Artificial Recharge could play an important role in the mitigation of the potential impacts discussed herein, especially with regard to potential impacts related to pumping-induced flow from the Chesley Brook Springs. Although the AR opportunity is under full investigation at the time of this writing, the purpose of using Artificial Recharge to replenish groundwater within this Aquifer would be to pump excess water from the Lamprey River (during relatively "wet" seasons) into the contributing area of the Spruce Hole Aquifer and allow it to infiltrate into the ground. This would supplement the natural recharge available from precipitation and replenish the cone of depression established by previous pumping of the Production Well. Some of the artificially recharged water will also serve to supplement flows to Chesley Brook Springs. Therefore, pumping-induced impacts to wetlands along Chesley Brook in the area of the Springs and to flows within Chesley Brook are anticipated to be mitigated with the use of AR. Therefore, we also consider Artificial Recharge to be used as a mitigation tool.

XIV. LIMITATIONS

EGGI has collected and evaluated the available technical data according to professionally accepted scientific standards. It is to be recognized that the testing program was limited to that which is presented in this report and occurred during a specific climatic period. The recommendations provided herein regarding potential and future yield of Production Well DGD-PW2, the quality of groundwater produced from Well DGD-PW2, and the potential adverse impacts to pumping as described herein, etc., represent EGGI's professional opinion based upon the data collected. Nothing stated or inferred in this report constitutes a warranty written or implied.

XV. REFERENCES

Ballestero, T.P. and T.D. Lee, 2000, Final report for Hydrogeologic Studies of the Spruce Hole Bog Sand and Gravel Formation, for University of New Hampshire, Durham, NH.

Ballestero, T.P, T.D. Lee and S.D. Miller, 1995, Summary of the 1994 efforts in the study of ground water near the Spruce Hole Bog; for Town of Durham and University of New Hampshire.

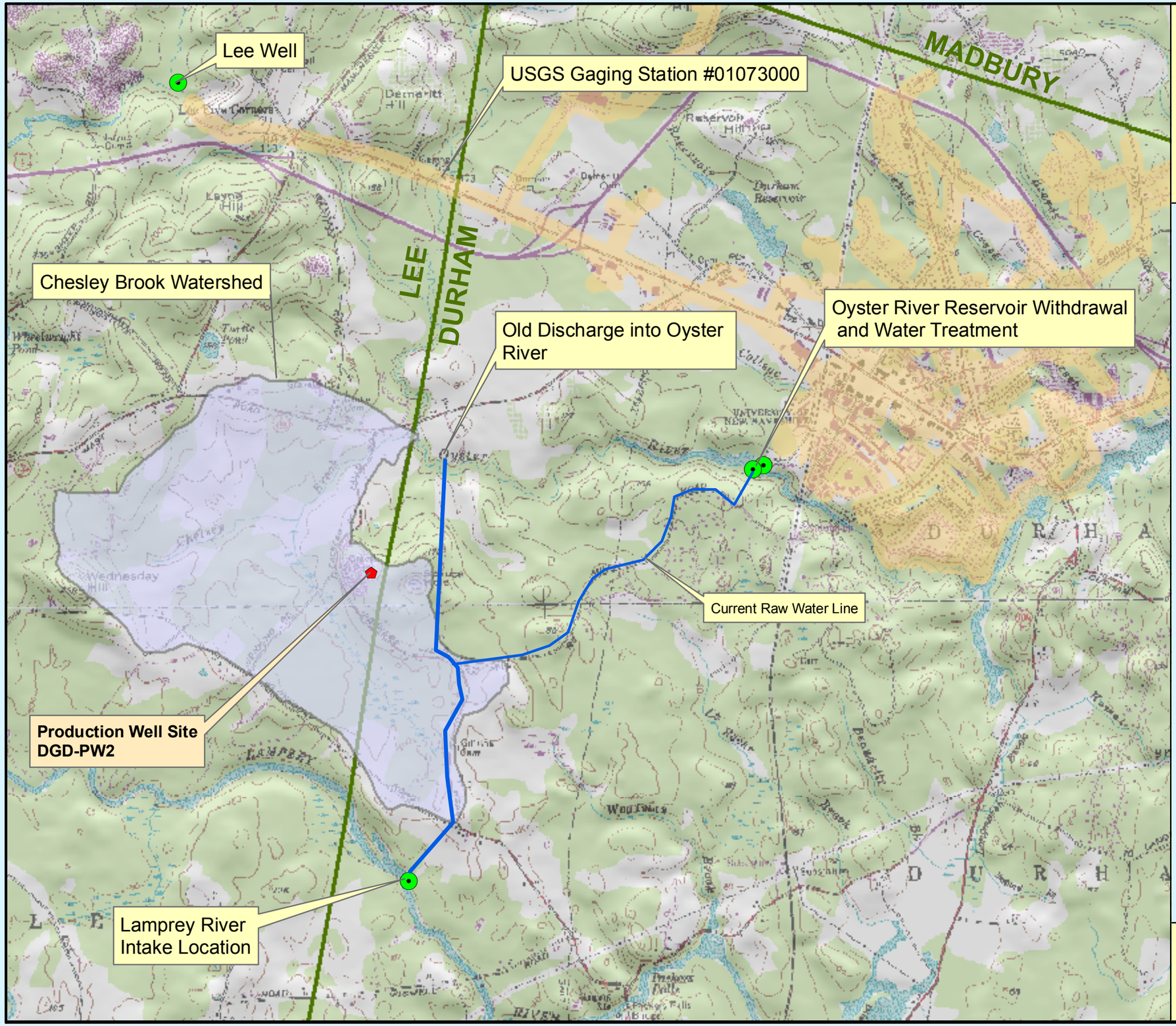
Emery & Garrett Groundwater, Inc., 2008, Preliminary Hydrogeologic Investigation, Town of Durham-University of New Hampshire, Groundwater Development, Durham/UNH Production Well #2, Durham, New Hampshire.

Miller, D.D., 1996, The vegetation and tree ring history of Spruce Hole Bog, MS Thesis for Department of Biology, UNH

Neuman, S.P., 1975. Analysis of pumping test data from anisotropic unconfined aquifers considering delayed yield, Water Resources Research, vol. 11, no.2, pp. 329-342.

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage, *Transactions, American Geophysical Union* 16: 519–524.

FIGURE 2
Approximate Area Served by Existing Water Distribution System For UNH/Durham Water System



Legend

- Production Well Site
- UNH/Durham Public Water Resource
- Lamprey River Trunk Line
- Chesley Brook Watershed
- Extent of UNH/Durham Water System

(Date Source: NHDES GIS Database)

N

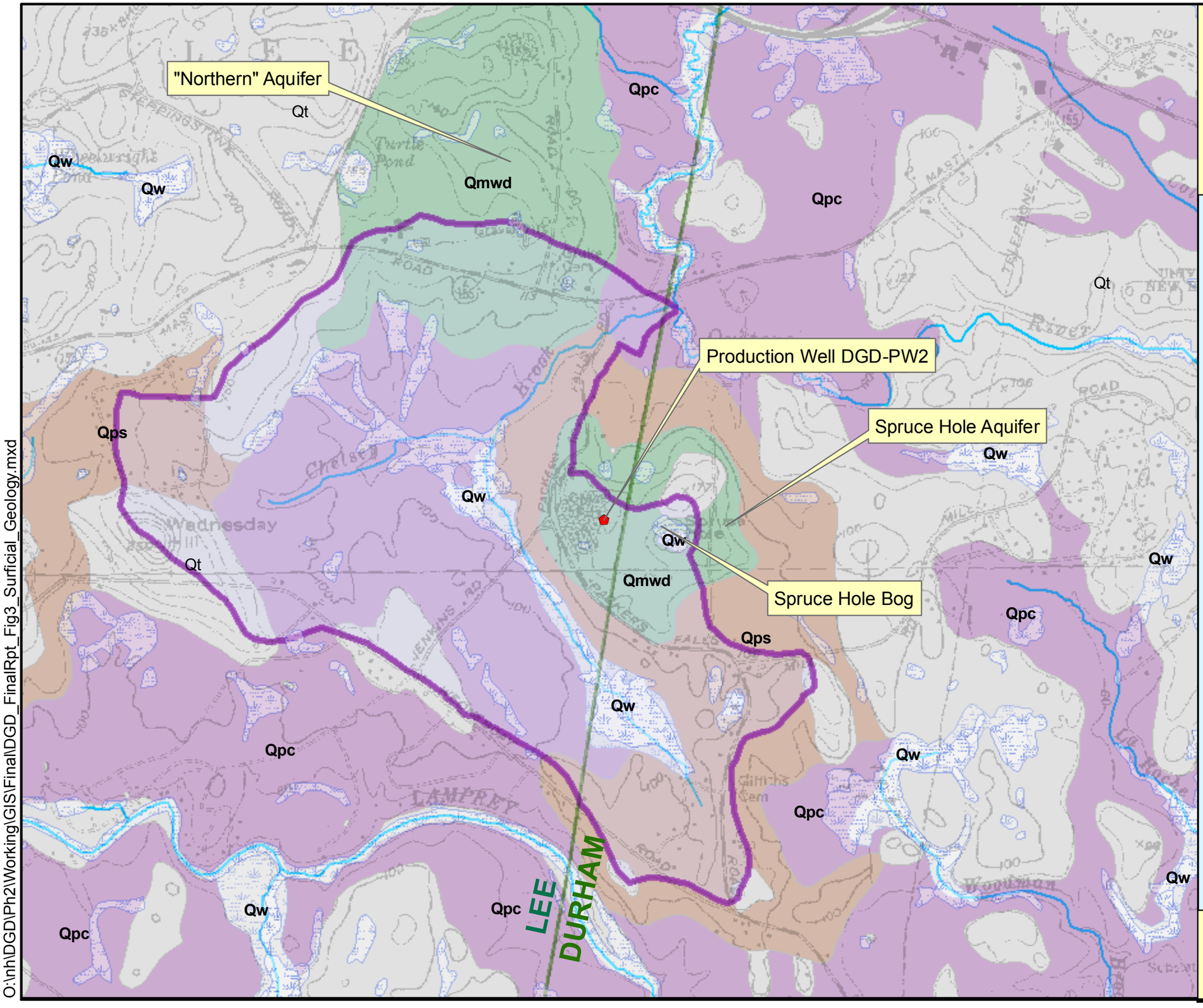
1:24,000
1 inch equals 2,000 feet

FIGURE 2

Emery & Garrett Groundwater, Inc.

FIGURE 3

Surficial Geology of the Area Around Production Well DGD-PW2 UNH/Durham Water System



Legend

- Production Well Site
- Streams and Rivers

Surficial Geology

Geologic Formation

- Qmwd - Marine Delta
- Qpc -Presumpscot Formation
- Qps - Sandy Presumpscot Formation
- Qw - Wetlands
- Qt - Glacial Till

(Background Data Source: NHDES GIS Database)

1:15,000
1 inch equals 1,250 feet

N

FIGURE 3

Emery & Garrett Groundwater, Inc.

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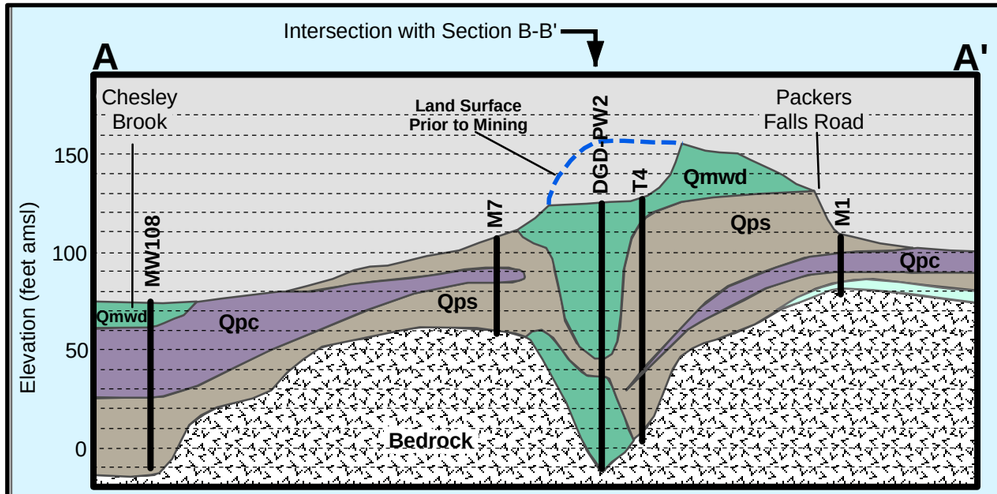
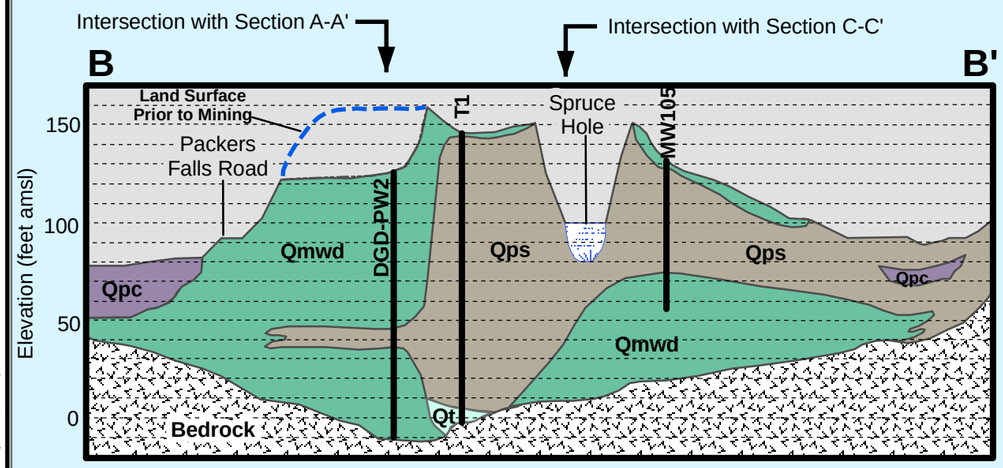
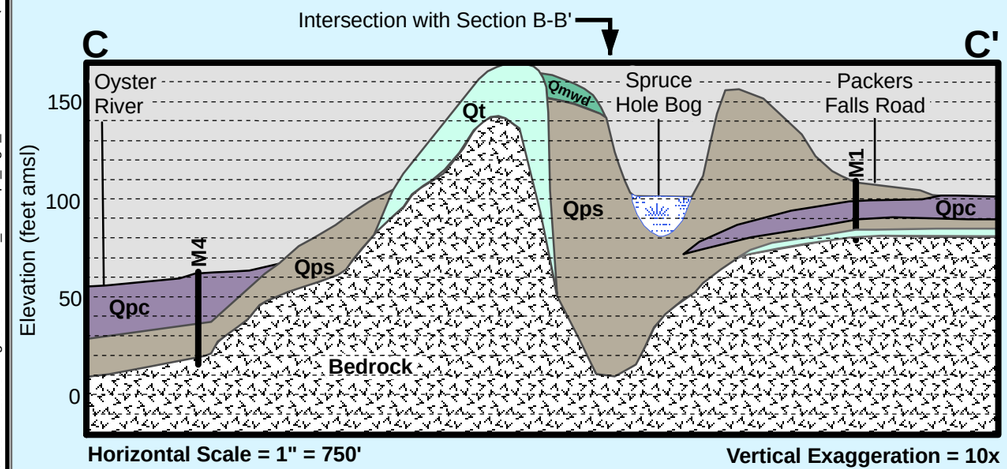
FIGURE 5

Schematic Geologic Cross-Sections
UNH/Durham Water System
Durham, New Hampshire

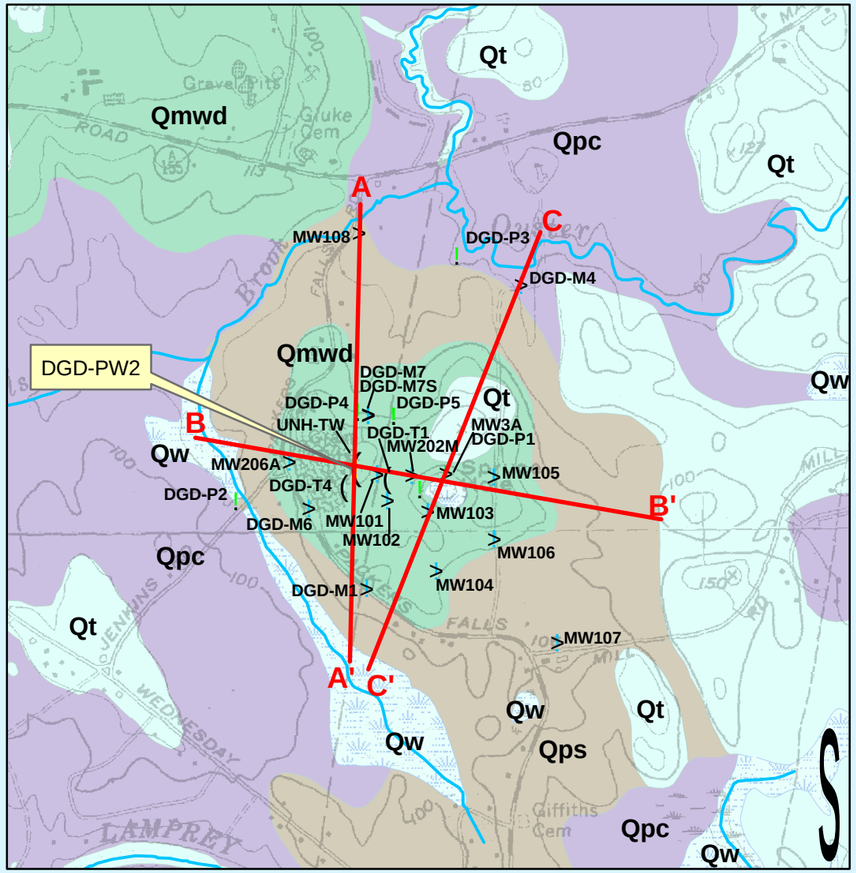






Horizontal Scale = 1" = 750'

Vertical Exaggeration = 10x



1:18,000

1 inch equals 1,500 feet

NOTE: Interpretive surficial geology displayed in the cross-sections is based on field mapping and well logs and does not always match the published surficial geology.

Legend

- Production Well Site
- Streams and Rivers
- A — A' Location of Geologic Cross-Section

Surficial Geology

Geologic Formation

- Qmwd - Marine Delta
- Qpc - Presumpscot Formation
- Qps - Sandy Presumpscot Formation
- Qw - Wetlands
- Qt - Glacial Till

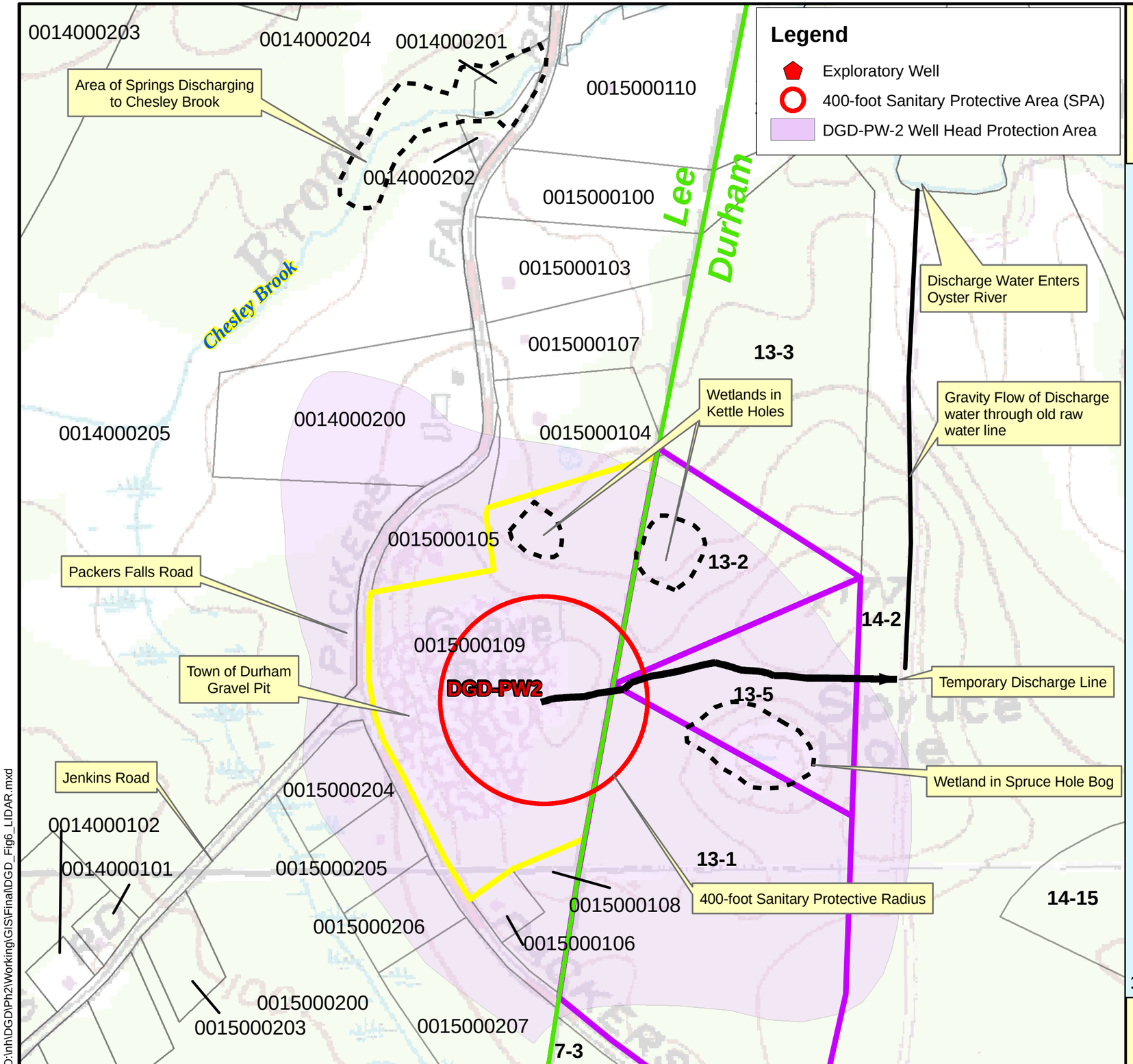
(Background Data Source: NHDES GIS Database)

FIGURE 5

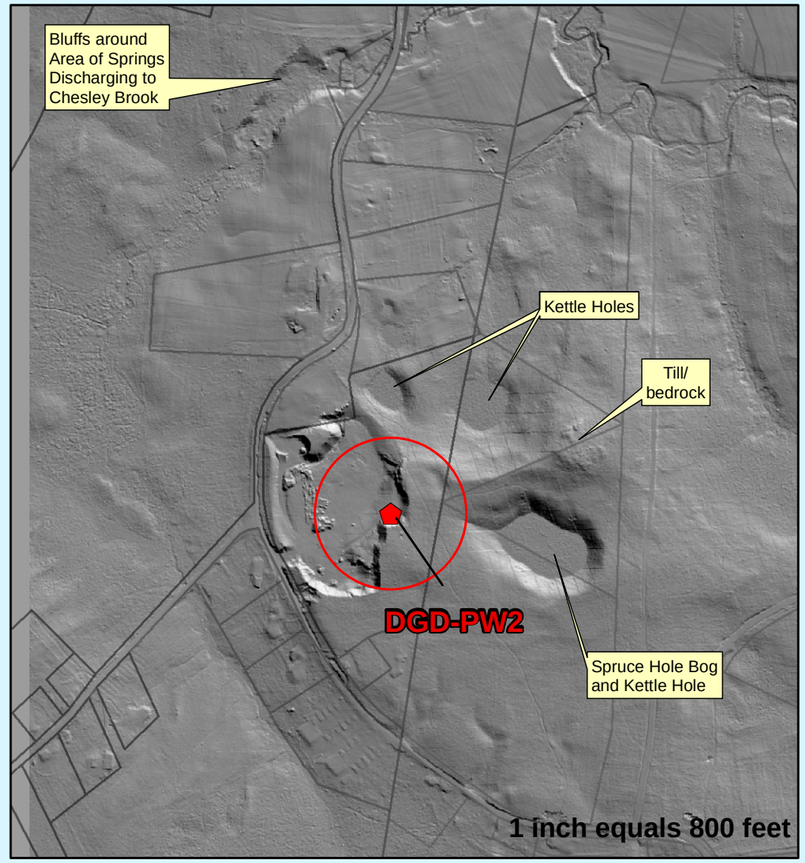
Emery & Garrett Groundwater, Inc.

O:\nh\DGD\Ph2\Working\GIS\Final\DGD_FinalRpt_Fig5_XSections.mxd (last modified: April 4, 2012)

FIGURE 6
Wellhead Protection Area,Tax Map, and Lidar Image of Production Well DGD-PW2 Site UNH/Durham Water System



LIDAR Image of View



N

1:4,800
1 inch equals 400 feet

Legend

Town Boundary

Town of Durham Properties within the SPA

13-5

Town of Lee Properties within the SPA

0015000105

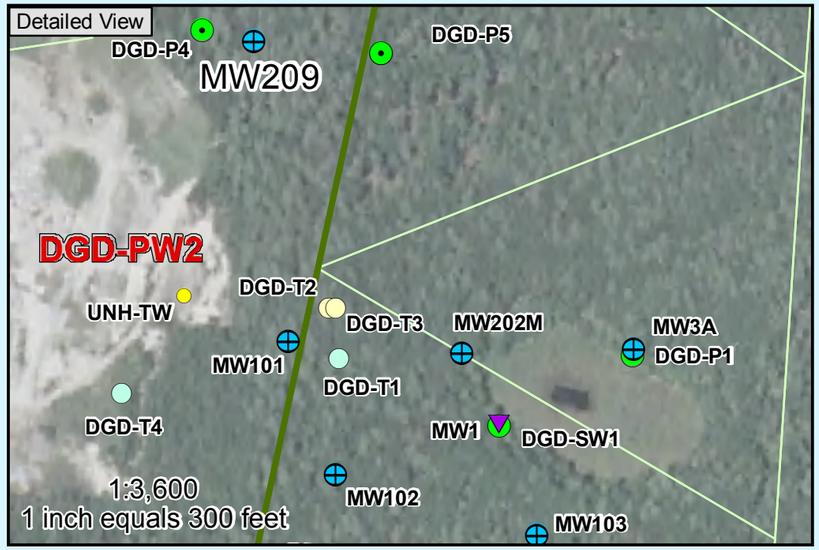
O:\nh\DGD\Ph2\Working\GIS\Final\DGD_Fig6_LIDAR.mxd

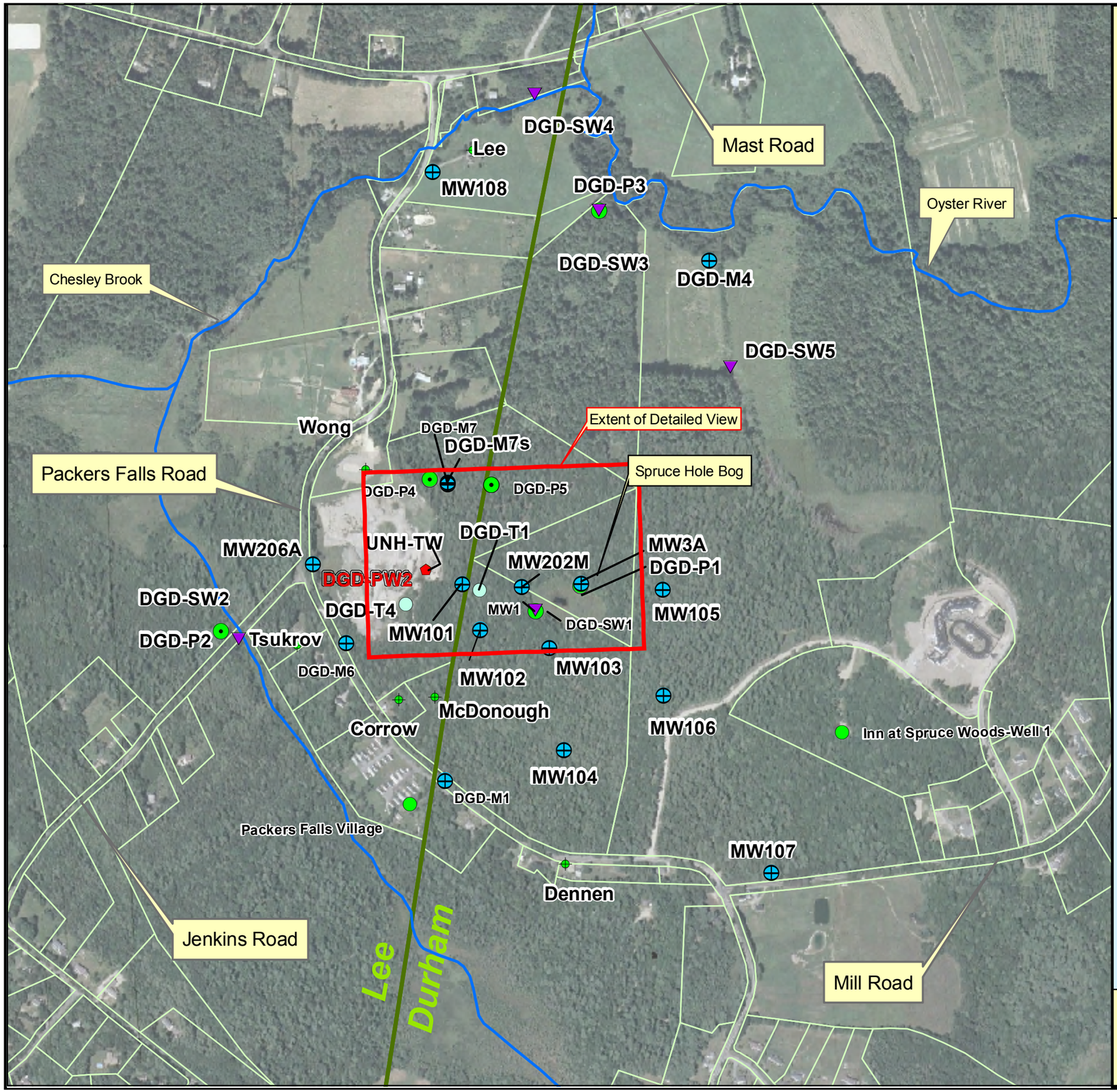
FIGURE 6

Emery & Garrett Groundwater, Inc.

FIGURE 8

Final Monitoring Locations for the Eight-Day Pumping Test of Production Well DGD-PW2 UNH/Durham Water System





Legend

- Production Well DGD-PW2
- Existing Community Supply Well
- UNH-TW Test Well
- EGGI Exploratory Test Well
- Domestic Well
- Monitoring Well
- Piezometer
- Surface Water Station

N

1:7,200
1 inch equals 600 feet

O:\nh\DGD\Ph2\Working\GIS\Final\DGD_FinalRpt_Fig8_Monitoring Locations.mxd

FIGURE 8

Emery & Garrett Groundwater, Inc.

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

August 3, 2012

John Brooks
Emery & Garrett Groundwater, Inc.
P.O. Box 1578
Meredith, NH 03253

RE: Final Report -- Large Well Siting/Large Groundwater Withdrawal Permit Application
Durham/UNH Water System, PWS ID 0691010
Well #2 (DGD-PW2)
Lee, New Hampshire

Dear Mr. Brooks:

The New Hampshire Department of Environmental Services (DES) has conducted a review of the final report submitted in support of a community well siting and large groundwater withdrawal permit application (Final Report) titled "Final Hydrogeologic Investigation Town of Durham-University of New Hampshire Groundwater Development UNH/Durham Production Well DGD-PW2" prepared by Emery & Garrett Groundwater, Inc. (EGGI) on behalf of the Durham/UNH water system (Durham/UNH), dated March 28, 2012. In summary, Durham/UNH is seeking large well siting approval and a large groundwater withdrawal permit for one new overburden production well, designated well DGD-PW2, located in the town of Lee just west of the Durham-Lee town line, east of Packers Falls Road and west of Spruce Hole Bog. The total proposed permitted production volume is 1,044,000 gallons per day (gpd), or 725 gallons per minute (gpm) over a 24-hour period, with a maximum annual withdrawal volume limitation of 63 million gallons. Durham/UNH is pursuing the proposed groundwater withdrawal in conjunction with an artificial recharge project in which natural recharge to the overburden aquifer from which DGD-PW2 withdraws groundwater (herein referred to as the Spruce Hole Aquifer) will be artificially supplemented with surface water withdrawn from the Lamprey River [DES Groundwater Discharge Permit No. GWP-201111101-L-001].

This letter contains DES' comments on the Final Report in accordance with: RSA 485-C:21, *Approval for Large Groundwater Withdrawals*; New Hampshire Administrative Rules Env-Wq 403, *Large Groundwater Withdrawals*; and New Hampshire Administrative Rules Env-Dw 302, *Large Production Wells for Community Water Systems*. The following are DES' comments:

I. General Comments

a) DES acknowledges that Durham/UNH is requesting an increase of the proposed permitted production volume of DGD-PW2 from 1,008,000 gpd (700 gpm) [proposed in the Preliminary Application] to 1,044,000 gpd (725 gpm) based on the constant rate pumping test performed on the well. Given EGGI's conservative assumptions in developing the potential impact area, DES does not require any modification of the potential impact area due to the revised production volume of DGD-PW2.

b) In keeping with DES' prior correspondence, although comments on the Final Report for DGD-PW2 are provided below, final approval for the well can not be issued until a water conservation plan, completed in accordance with Env-Wq 2101, has been submitted and approved by DES' Water Conservation Program. Based on recent communication with EGGI, DES understands that Durham/UNH anticipates

submitting a water conservation plan by the end of August 2012. If EGGI or Durham/UNH have any questions regarding the water conservation rule requirements, or need further assistance compiling the plan, please contact Stacey Herbold at (603) 271-0659 or stacey.herbold@des.nh.gov.

c) Provide copies of the Well Completion Reports (or State Well ID numbers if available) for the test and monitoring wells installed as part of this investigation and filed with the NH Water Well Board by the NH-licensed water well contractor that constructed the wells.

II. Community Well Siting Requirements

a) With reference to the 400-foot radius sanitary protective area (SPA) of DGD-PW2 and the properties depicted in Figure 6, DES approves a waiver of the requirements of Env-Dw 302.06(d) for the portion of Durham Tax Map 13, Tax Lot 13-2 contained within the SPA. DES' decision to grant a waiver is based on a review of the information included in section III of the Final Report. This waiver is approved based on the fact that the property is currently undeveloped, and access to the portion of the property within the SPA is limited. This approval is conditional upon the current undeveloped status of the portion of the property within the SPA being maintained.

b) With reference to the refined Wellhead Protection Area (WHPA) of DGD-PW2 and the updated potential contamination source (PCS) inventory depicted in Figure 23, and comment No. 5 of DES' letter dated October 2, 2008, the Packers Falls Village mobile home park shall be added to the PCS inventory and included in any future Wellhead Protection Program (WHPP) established by Durham/UNH, as necessary.

III. Large Groundwater Withdrawal Permitting Requirements

a) Impact Description (Env-Wq 403.17)

i. *Surface Water and Wetland Resources*: The conceptual hydrologic model of the withdrawal presented by EGGI in the Final Report identifies spring discharge to Chesley Brook as a significant sink for groundwater flow in the Spruce Hole Aquifer. Under non-pumping conditions, the dominant groundwater flow direction within the aquifer is northward toward the springs which discharge to Chesley Brook along its south side, just west of where the brook crosses under Packers Falls Road, approximately 2,200 feet north of DGD-PW2. Based on the conceptual model and a water budget analysis, the Final Report states that groundwater discharge to Chesley Brook will be reduced under any pumping scenario of DGD-PW2, as the total volume of groundwater draining from the aquifer is reduced. EGGI estimates that the withdrawal from DGD-PW2 will reduce annual groundwater discharge to the springs by between 50 and 69% (52-73 million gallons per year, or 100-138 gpm). DES acknowledges that these estimates do not take into consideration using artificial recharge to supplement the total amount of groundwater available in the aquifer; and that artificial recharge will likely serve to lessen reductions in spring flow to some degree.

Based on the above-cited estimates, DES concurs with EGGI in that there is the potential for the withdrawal from DGD-PW2 to impact flow in Chesley Brook, particularly during times of the year when spring discharge and groundwater baseflow comprise a greater proportion of stream flow. DES also concurs that spring flow/surface water flow reductions could potentially impact riparian wetlands that occur at and downstream of the springs. The potential for these impacts to occur is further supported by the reduction in stream flow observed at surface water station DGD-SW4 during the recovery period of the withdrawal testing program; although, DES acknowledges that quantifying the reduction is confounded by the influence of a rainfall event near the end of the pumping period and subsequent stream flow recession during the recovery period.

Relevant to this issue [and referenced on page 34 of the Final Report] is the fact that within the reach of Chesley Brook that includes the springs, the New Hampshire Fish and Game Department (NHFGD) has identified a 'dense' population of American brook lamprey (*Lampetra appendix*; herein referred to as ABL), which is listed as a state endangered species. Based on information provided by the NHFGD staff that conducted fish surveys of Chesley Brook, the health and abundance of this population is attributed to the habitat provided by Chesley Brook and the influx of groundwater from the springs. By reducing the amount of groundwater discharging from the springs, and subsequently reducing stream flow in the brook, water quality parameters could be shifted outside of preferred ranges; or different stream habitats used by the ABL during its various life stages could be reduced to unsuitable conditions or dewatered. These scenarios could pose an immediate risk to individual members of the species, and consequently the species as a whole given its rarity (M. Carpenter, NHFGD; personal communication, July 12, 2012; letter, July 30, 2012).

In consideration of the above comments, DES believes there may be the potential for the withdrawal from DGD-PW2 to cause a violation of the adverse impact criteria of RSA 485-C:21, V-c.(f) and (g), specifically by reducing surface water levels or flows in Chesley Brook that will, or do, cause a violation of the State's surface water quality standards specified in Env-Wq 1700; or by causing a net loss of values for submerged lands and wetlands as set forth in RSA 482-A. Given the documented presence of a state endangered species within the reach of Chesley Brook most likely to be affected by the withdrawal from DGD-PW2, Durham/UNH shall conduct a site-specific instream flow study of Chesley Brook to determine the flow conditions that must be maintained to provide suitable habitat conditions for the ABL during its various life stages (see comment No. III.b)i. below).

Per the position presented on page 32 of the Final Report, DES concurs that the withdrawal from DGD-PW2, as proposed, is not likely to significantly impact flow in the Oyster River.

ii. *Private Water Supply Wells*

1. For private wells that were monitored during the withdrawal testing program, provide copies of the plots depicting the monitoring results to the respective property owners. The monitoring results shall be accompanied by a cover letter that provides a contact name and telephone number for both Durham/UNH and DES for any questions regarding the water level plots.

2. Given the water level influence observed in the private overburden (dug) well serving the Tsukrov property (Lee Tax Map 15, Tax Lot 2-4) during the withdrawal testing program, and the amount of water level drawdown estimated to occur during the continuous operation of DGD-PW2 [as described on page 30 of the Final Report], DES concurs that the use of DGD-PW2 could disrupt the use of the Tsukrov well, and cause a violation of the adverse impact criterion of RSA 485-C:21, V-c.(a), specifically by reducing the withdrawal capacity of the Tsukrov well as a result of the reduction of available water that is directly associated with the withdrawal. As such, provide a plan to mitigate adverse impacts to the Tsukrov well, in accordance with Env-Wq 403.30, *Replacement of Sources Adversely Impacted by Withdrawal.* Implementation of the mitigation plan prior to initiating a withdrawal from DGD-PW2 shall be a condition of any large groundwater withdrawal permit issued.

3. Given the water level influence observed in some of the private wells monitored, provide a draft plan for providing an alternative water supply (i.e., a draft "Source Replacement Plan") that would be implemented by Durham/UNH in the event of an adverse impact to a private water

supply source, in accordance with the criteria and procedures in Env-Wq 403.30, *Replacement of Sources Adversely Impacted by Withdrawal*. The plan should propose a mechanism for meeting short-term water supply needs in situations where a long-term solution may be necessary. At a minimum, the plan shall need to establish a protocol that Durham/UNH intends to follow to replace the water supply of a private well user in the event of an adverse impact, to include a statement that any work on a private well, if deemed necessary, will be conducted by a NH-licensed water well contractor/pump installer.

4. Provide a figure depicting the following information overlain on a current tax map: 1) wells that were monitored during the withdrawal testing program and their associated 180-day water level drawdown estimates; 2) estimated 180-day drawdown contours; and 3) 180-day zone of influence. Where information is available (e.g., from completed private well survey forms, windshield surveys, etc.) the map should differentiate between properties that are served by bedrock wells and those that are served by overburden (dug) wells, and properties should be labeled with their tax map and lot number. Also, provide a table to accompany the map that contains the ownership information for each property within the estimated 180-day zone of influence that is served by a private well.

   Note that as a condition of any large groundwater withdrawal permit issued, Durham/UNH shall send a letter to the owners of all properties served by private wells or public wells not owned by Durham/UNH within the estimated 180-day zone of influence of the withdrawal, notifying them that their well may be influenced by the withdrawal and that a source replacement plan is available if they would like a copy, and providing them with contact information for Durham/UNH and DES in the event they believe they may be adversely impacted by the withdrawal.

iii. *Aquifer Recharge*: Based on the conceptual model and water budget analysis presented in the Final Report and groundwater level recovery trends observed during the withdrawal testing program, DES believes that the use of DGD-PW2 at the proposed permitted production volume could potentially result in groundwater being withdrawn from the aquifer faster than it is recharged by natural processes causing water levels in the aquifer to decline over time, and cause a violation of the adverse impact criterion of RSA 485-C:21, V-c.(k), specifically by causing the long-term predictable rate of replenishment of the Spruce Hole Aquifer to be exceeded. This stated, however, DES also believes that the proposed groundwater withdrawal from DGD-PW2 can not be viewed separately from Durham/UNH's artificial recharge project, and that artificial recharge will serve to mitigate any potential adverse impacts related to the rate of aquifer recharge. As such, implementation of the artificial recharge project shall be a condition of any large groundwater withdrawal permit issued. To ensure an adverse impact does not occur, Durham/UNH shall implement a water level monitoring program to monitor the trend of groundwater levels in the aquifer over time (see comment No. III.b)ii. below).

b) Impact Monitoring and Reporting Program (Env-Wq 403.24): An impact monitoring and reporting program shall be conducted when available information is not sufficient to verify that adverse impacts from a large groundwater withdrawal will not occur, provided the available information does not suggest that an impact is irreversible or will occur immediately. The following is a summary of the components DES anticipates would be included as part of a proposed program and associated upfront studies.

i. *Instream Flow Study of Chesley Brook*: Propose a site-specific instream flow study of Chesley Brook, focusing on the stream reach extending from Packers Falls Road upstream to the confluence with the unnamed tributary stemming from the southeast. Any study proposed shall be prepared by a qualified

professional and address such items as the following (to the extent they are suitable for the site) and any other technically appropriate issues determined to be relevant:

- A literature review to compile information on the ABL, and the species' environmental requirements (e.g., physical habitat, water quality preferences, etc.) during its various life stages;
- A plan to conduct the following over a minimum baseline (pre-withdrawal) period of three consecutive years:
  - Instream habitat surveys of the study reach, including field mapping of physical habitats, channel morphology, instream cover, substrate composition and distribution, and stream profile transects, etc.;
  - Fish surveys, in consideration of input from NHFGD;
  - Stream flow and stream stage monitoring to characterize the baseline (pre-withdrawal) flow regime of the study reach, including quantifying contributions to the study reach from the main stem of Chesley Brook, the unnamed tributary, and the springs;
  - Instream water quality monitoring within the study reach to characterize baseline (pre-withdrawal) ranges of parameters such as temperature, pH, dissolved oxygen, etc. at locations both upstream, at, and downstream of the springs;
  - Riparian wetland surveys at and downstream of the springs during the growing season, including field mapping of wetland boundaries, plant community inventorying, hydrologic monitoring (e.g., assessing connectivity with Chesley Brook and the springs, surface water and groundwater level monitoring, quantifying the degree and timing of inundation/saturation), functions and values assessments, etc.; and
- Identification of a reference site or sites that can serve as "controls" within the context of a long-term impact monitoring and reporting program to document natural trends and variations in conditions not influenced by the proposed groundwater withdrawal.

DES anticipates that the goals of any study proposed will be to: 1) determine the flow conditions that must be maintained in Chesley Brook to provide suitable habitat conditions for the ABL during its various life stages; and 2) define the components of a long-term impact monitoring and reporting program, and potentially a mitigation plan, to ensure that adverse impacts do not occur to Chesley Brook, its riparian wetlands, and their users, specifically the ABL. Implementation of the instream flow study and impact monitoring and reporting program shall be a condition of any large groundwater withdrawal permit issued.

ii. *Groundwater level monitoring:* DES anticipates that the groundwater level monitoring plan included as a condition of any large groundwater withdrawal permit issued shall adopt the monitoring plan that is already approved as part of Durham/UNH's artificial recharge project, with the addition of monitoring well MW-104 as a background well.

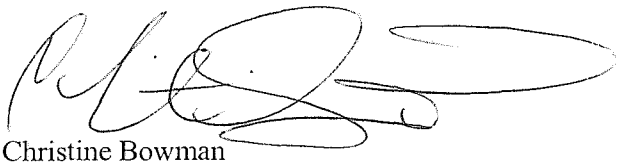
Note that although not proposed in the Final Report, as a condition of any large groundwater withdrawal permit issued, Durham/UNH shall monitor water levels in DGD-PW2. These measurements will serve as a comparative benchmark for water level fluctuations at other monitoring

locations, and, in the context of sustainable use, enable Durham/UNH to track water levels in their production well over time.

The above-requested information and materials shall be submitted to DES within 180 days of the date of this letter. In accordance with Env-Wq 403.19(c)(2), if the specified information and materials are not provided to DES by January 30, 2013, the application will be deemed to have been withdrawn, unless an extension is requested and granted pursuant to Env-Wq 403.36.

If you have any questions about this letter or any other groundwater permitting issues, please contact me at (603) 271-8866 or christine.bowman@des.nh.gov.

Sincerely,



Christine Bowman
Hydrogeologist
Drinking Water and Groundwater Bureau

cc: David Cedarholm, Durham/UNH Water System
Brandon Kernen, Stephen Roy, Richard Skarinka, Cynthia Klevens, Derek Bennett, Stacey Herbold, Ted Diers, Philip Trowbridge, Owen David, Wayne Ives; DES (email)
Matthew Carpenter, Benjamin Nugent, Carol Henderson; NHFGD (email)
Town Council, Town of Durham
Board of Selectmen, Town of Lee
Emeritus at Spruce Wood
Oyster River Condominium Association
Packers Falls Village

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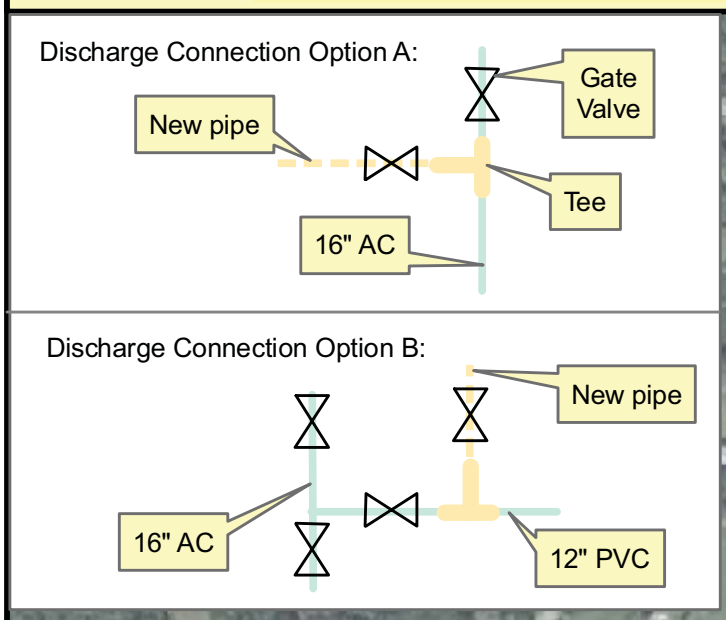
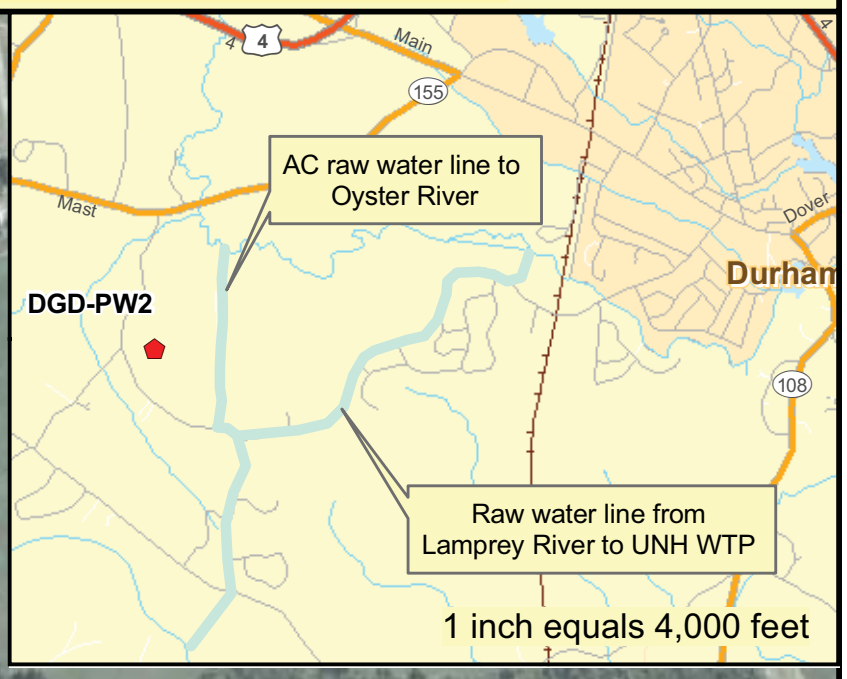
FIGURE 1 - Options for Electrical and Water Discharge Line Locations
UNH/Durham Water System





Mast Road

Chesley Brook

Packers Falls Road

16" AC Raw Water Discharge Line to Oyster River

Proposed Artificial Recharge Basin No. 1

Woods Road

Production Well DGD-PW2

Option A: Combination Well & AR Discharge Line Connected to 16" AC Raw Water Line

Existing Manhole

Proposed Artificial Recharge Basin No. 2

Connection point

3-Phase Power Option A: Overhead along Packers Falls Road and within sand pit

Mill Road

Connection point

3-Phase Power Option B: Overhead along Packers Falls Road and underground along woods road.

Option B: Dedicated Well Discharge Line Connected to Hard Pipe on Mill Road

Lamprey River "Hard Pipe" Raw Water Line to UNH Water Treatment Plant

O:\nh\DGD\Ph3\GIS\DGD_PH3_ARFig_electrical and pipeline options.mxd January 5, 2012

1 inch equals 400 feet

FIGURE 1

Emery & Garrett Groundwater, Inc.