Appendix E

College Brook Report

This Appendix features the report of the College Brook Restoration Group for the Mill Plaza Study Committee. This work was done pro-bono by local experts in natural resources and stream ecology.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

(1) BACKGROUND

The College Brook Restoration Work Group volunteered to prepare a brief report for the Mill Plaza Study Committee to identify the opportunities to restore the ecological health of College Brook (the Brook) associated with the proposed redevelopment of the Mill Plaza. The audiences for this report are Mill Plaza Study Committee members and AIA150 Design teams.

(2) SUMMARY

The extent of pavement and current drainage and snow storage practices on the Plaza property date from the previous development phase during the 1960's, and would not be permitted today. Current regulations require stormwater management in upland areas. The AIA150 design process, in partnership with the expertise at the UNH Stormwater Center, provides an exciting opportunity to leverage that work with ecological restoration in lowland flood plain, wetlands, and stream corridor of College Brook, as well as providing linkages for the existing footpath network in the vicinity.

In summary, the redevelopment of the Mill Plaza property provides a major opportunity to:

(a) Minimize and then manage stormwater on site;

(b) Maximize the vegetated buffer between Plaza activities and College Brook;

(c) Integrate inviting access to a natural oasis adjacent to the Mill Plaza.

(3) OBJECTIVES FOR COLLEGE BROOK RESTORATION

The objectives of stream restoration would be to:

(a) Improve water quality and reduce the current negative water quality impacts of the Brook on the Oyster River and Great Bay.

(b) Improve the flood control capacity and other hydrological functions of the Brook.

(c) Make progress toward restoring native species currently displaced by invasives in the corridor.

(d) Enhance the current vegetated buffer to improve its function as a corridor for wildlife, as an aesthetic and noise barrier between the commercial and residential zones, and as a recreational resource for pedestrians.

(2) COLLEGE BROOK IN CONTEXT

Location and Character: College Brook is a tributary to the Oyster River, that flows into Great Bay. Over the past decades, the original course and character of the Brook has been substantially modified from its headwater near Route 4 until it flows into the Mill Pond, which joins the tidal Oyster River below the Mill Pond dam. Most of the upper watershed is on the UNH campus, where the Brook itself flows through a combination of ditches, underground pipes, and landscaped and relatively undisturbed natural areas. Extensive engineering of the Brook has occurred for many decades, both on and off the UNH campus. Early maps of UNH (circa

REPORT TO THE MILL PLAZA STUDY COMMITTEE

1920's), refer to College Brook as "College Drain." More recently, photos taken in the mid 1960's show that the Mill Plaza site was an open agricultural field with very limited tree cover along the banks of the Brook, suggesting possible water quality impacts to the Brook from the site even before the 1968-69 construction of the shopping center and parking lot. See Table 1 College Brook Context (page 3) for more detail.

What we know: In our initial research, we found a publication, *Stream Corridor Restoration Principles, Processes, and Practices*, that outlines a very clear process for identifying and implementing a restoration plan for stream corridors (Appendix A). We also found what appears to be a stormwater management/ ecological restoration project of similar scope and scale on a college campus in eastern Pennsylvania (Appendix B). Additionally, the UNH Stormwater Center is another resource (Appendix C). We also have some data on water quality, quantity, and vegetation in the College Brook stream corridor, and a brief Brook timeline (Appendix D) and historic photos (Appendix E) of the site before development of the Mill Plaza.

Water quality along the length of the Brook is poor, and has been measured at least since 1991 (Figure 1 below and Table 2, page 4). Nitrogen levels are high. Chloride levels are very high, and the Brook was recently listed as impaired due to chloride levels by the NH Department of Environmental Services. Although some water quality parameters have improved since 1991 (BOD, DO, and phosphate in particular), chloride and nitrate levels appear to have increased.
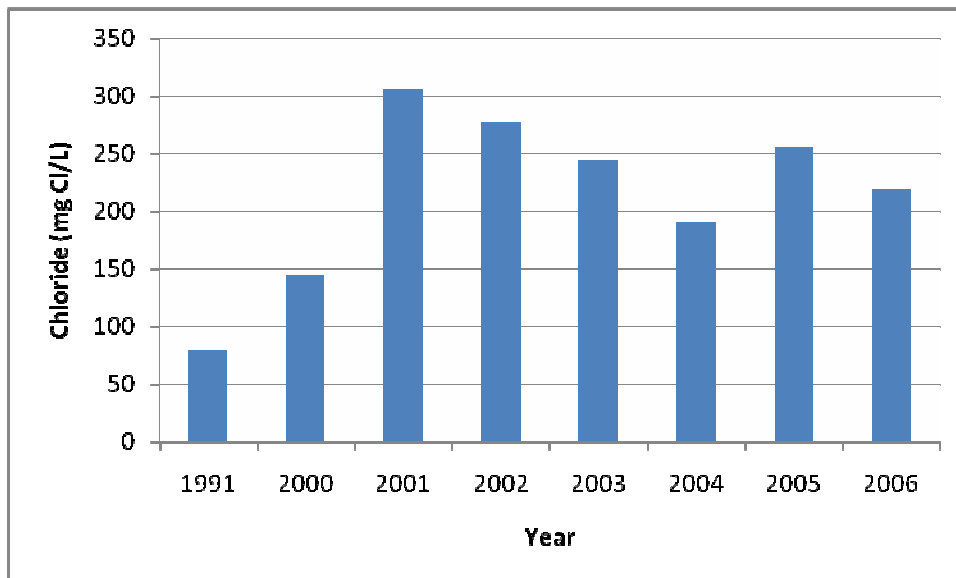
Figure 1. *Average annual chloride concentrations in College Brook based on monthly samples.*

The impact of the current Mill Plaza runoff is not well documented, as most historic data are available for the UNH campus only. Recent sampling by the UNH Water Resources Research Center, however, shows a large increase in nitrate concentrations between the edge of campus and the mouth of the Brook at Oyster River. A likely source for this increased nitrate is runoff from the mall parking lot, although other sources may contribute as well.

Water quantity: Although not included in this report, water quantity data, such as flow rates, flooding events, etc. and analysis are available from UNH experts such as Jamie Houle.

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TABLE 1 COLLEGE BROOK CONTEXT

THE OYSTER RIVER WATERSHED: The Oyster River watershed drains approximately 32 sq. miles, and includes portions of Barrington (headwaters), Nottingham, Lee, Madbury, Durham, and Dover. The Oyster River is the primary water supply source for the Town of Durham and UNH. College Brook is a freshwater tributary to the Oyster River, which is tidal below the Mill Pond dam.

COLLEGE BROOK WATERSHED

- Watershed size: approximately 620 acres (1 square mile)
- Length of main stream: approximately 9,375 feet (1.8 miles)
- Watershed high point = 100 feet; low point 10 feet.
- Elevation drop of main stream: approximately 60 feet

COLLEGE BROOK: Much of the upper watershed is located on the UNH campus; most drainage comes from upland areas into catch basins and culverts that discharge directly into College Brook.

COLLEGE BROOK

- Total length = 9,375 feet = 1.8 miles
- Piped length =2,340 feet = ¼ of length
- Channelized = 3,200 feet = 1/3 of length
- Total artificial = 5,540 feet = 1+ mile
- Natural, relatively free-flowing = 3,835 feet = ¾ mile
- Mill Plaza property frontage = approximately 1,000 feet

WATERCOURSE: College Brook flows through the UNH campus and enters Mill Pond adjacent to Chesley Drive, below the Mill Plaza site. The brook begins adjacent to the intersection of Mast Road (Route 155A) and Route 4 by-pass, close to the UNH dairy operation, and the UNH athletic field complex, and flows through campus mostly in channelized ditches over much of the upper stream area.

When the brook enters College Woods, it returns to a stream-like character until it reaches Colvolos Drive. There are two tributary streams: one begins south of the Channel 11 complex and flows along the edge of the athletic fields where it joins with the main brook; the second begins in College Woods, flowing through the woods and the entreprenurial campus, through a ditch along the railroad tracks, where it joins the main brook at the railroad tracks and Colvolos Drive. The brook flows under the railroad tracks adjacent to the entrance trail to the College Woods Natural Area, whereupon it flows underground, emerging in the center of campus, at Spaulding Hall. Then it flows through campus, more natural in state, where it extends across a narrow floodplain during periods of high water. The brook flows through a culvert under Parking Lot C and Mill Road before resurfacing next to the entrance to the Mill Plaza parking lot. In the Mill Plaza area, College Brook is in the lower part of its watershed, flowing through woods and past backyards of Chesley Drive and Faculty Road residences, flowing into Mill Pond at the Milne property.

Maps of the watershed on topo and aerial bases are included in Appendix G.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

TABLE 2 COLLEGE BROOK WATER QUALITY

Average chemistry of College Brook at multiple stations on UNH campus, from 1996-2006

Site	pH	Cond. us/cm	DO mg/L	BOD mg/L	TSS mg/L	DOC mg C/L	PO_4 µg/L	NH_4 µg N/L	Nitrate mg N/L	Chloride mg Cl/L	Sodium mg Na/L
CB0	7.03	1238	6.16	1.92	14.1	5.24	18	137	0.27	305	201
CB1	7.04	1118	7.42	2.16	11.5	5.66	20	189	0.25	292	195
CB2	7.24	658	11.14	2.09	13.3	4.57	19	71	0.86	157	103
CB3A	7.10	809	8.77	1.71	32.9	4.49	13	58	0.24	193	104
CB4	7.43	913	10.51	1.99	11.8	4.15	16	76	1.07	231	153
CB5	7.41	896	11.42	2.18	11.5	3.79	13	49	1.05	240	142

(Data: NH Water Resources Research Center, UNH, compiled by William H. McDowell**,** 11/26/07)

Sampling locations:

- CB0 is located adjacent to Rt. 4
- CB5 is at the edge of UNH campus, adjacent to the MUB, upstream from the Mill Plaza.

Key:

DO = Dissolved oxygen	BOD = Biochemical oxygen demand
TSS = Total suspended solids	DOC = Dissolved organic carbon
PO_4 = Phosphate	NH_4= Ammonium

What we don't know: The volunteer Work Group has not assembled any specific data about College Brook geomorphology, hydrology, or physical or chemical characteristics. We have made some brief observations about plant communities and wildlife. In addition, direct experience with stream restoration in New Hampshire appears to be quite limited. The following are needed to provide a more thorough base for specific restoration recommendations:

- Summary of current understanding of the Brook and the surrounding land- its history, geology, soils, flow rates, etc.
- Quantitative data about Brook responses to storm runoff and characteristics and extent of flooding.
- Impacts on Brook water quantity from increasing precipitation in Durham over the past century and increasing extent of impervious surfaces.
- Data about water quality in areas receiving Mill Plaza drainage.

Also, we have not found clear definition of the location of the southern property line in some sections.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

Additional challenges: In addition to the limitations above, challenges to Brook restoration include:

- The condition of the watershed and the Brook upstream from Mill Plaza, and the resulting increase in floodwaters and water quality impairments.
- Extensive presence of exotic invasive species in the Brook corridor adjacent to the Plaza.
- The need to identify and obtain funding sources and in-kind assistance to study the unknown elements of the Brook character needed to inform restoration work.

(3) FUNCTIONS, SERVICES, AND VALUES

Even in its degraded state, College Brook provides value. Its associated stream bank, wetlands, and floodplain adjacent to Mill Plaza provide and support a range of interrelated essential ecological services and functions as well as social values, including:

(a) Flood control (temporary storage of flood waters)
(b) Groundwater recharge (from the Brook) and discharge (to the Brook)
(c) Water quality improvement (sediment and nutrient uptake, storage and reduction)
(d) Air quality improvement (cool and clean airflow)
(e) Habitat for plants and animals (aquatic, wetland, and upland species)
(f) Scenic and other aesthetic qualities (trees, flowers, fall foliage, bird songs, etc.)
(g) Recreational opportunities (walking paths, birding, etc.)
(h) Link with the town's history (as shown by historical photos and records)

(4) CAUSES AND EXTENT OF DEGRADATION IN COLLEGE BROOK

The combination of artificial management through portions of the UNH campus, increased impervious surfaces resulting from the development of the watershed, and previous filling on campus and in the vicinity of the Mill Plaza have degraded the Brook's water quality, stressed its ability to conduct flood flows, and reduced its capacity to absorb and slowly release stormwater.

In addition, a variety of human activities associated with urbanization in the Mill Plaza, Mill and Faculty Roads, and Chesley Drive neighborhoods such as pavement, disturbed soils, oil and gasoline spillage, invasive plants, loose pets, bird collisions with windows, etc., compromise the College Brook stream corridor as high value wildlife habitat. Maintaining or improving functional wildlife connections between the Mill Plaza stream corridor and adjacent green spaces on private and public properties is an essential consideration in determining the future wildlife habitat values. Wildlife such as birds, deer and smaller mammals are very adaptable, and if provided any relatively natural habitats will use the corridor for food, shelter, and movement.

(5) OPPORTUNITIES TO IMPROVE COLLEGE BROOK

The proposed redevelopment of Mill Plaza offers opportunities to contribute to the restoration of the ecological health of the stream reach adjacent to the Plaza, as well as to improve the Brook's capacity to absorb flood waters, and support community values. Given its history, upstream watershed condition, and current condition in the Mill Plaza area, "restoration" of College Brook will likely mean:

REPORT TO THE MILL PLAZA STUDY COMMITTEE

(a) Initial work to change the Brook's character such that it becomes closer to natural conditions;

(b) Ongoing work to protect its improved condition;

(c) Collaboration with UNH and NH DOT to develop an integrated watershed management plan that will ensure the Mill Plaza redevelopment has the maximum positive effects on the Brook.

The College Brook stream corridor at Mill Plaza is already an aesthetic benefit to the site, and an important buffer between the commercial and residential areas. So, in addition to improving the ecological health of the corridor, the AIA150 design/redevelopment process provides the opportunity to incorporate scenic, recreational, and aesthetic qualities. Improvements might include restoration and expansion of the vegetated buffer, along with providing walking paths, seating, and interpretive historical signs.

Phase 4 of the current UNH Master Plan includes plans to remove parking Lot C and "daylight" College Brook. While there is currently no budget and no schedule to complete this work, any stream restoration work completed as part of the Mill Plaza Re-development would be further enhanced by these efforts on the part of UNH.

(6) WHY IS IMPROVEMENT IMPORTANT?

Any ecological restoration of College Brook improves the functions, services, and values identified in section 3, to the benefit of the Town and its residents. Such improvement is important in order to:

(a) Improve and protect the water quality of the Oyster River and Great Bay.

(b) Increase the capacity of the Brook to provide flood control and other hydrological functions detailed in section 3.

(c) Cool and clean the air to offset the heat island effect from pavement, vehicles, and roofs.

(d) Provide green space that improves the public place of Mill Plaza. The Brook offers a unique opportunity to blend "new" green space with existing to make a much larger greenway.

(e) Improve the College Brook buffer as a barrier between commercial and residential areas and as a pedestrian throughway to enhance the quality of life of adjacent neighborhoods and improve Durham's status as a livable and walkable community.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

(7) CRITERIA FOR SUCCESS

Measurable indicators of success for this project include:

(a) **Water quantity**: Movement toward a stream hydrology (timing & amount of flows) that more closely approximates what would occur under natural conditions.

(b) **Water quality**: No net increase in sediment, nitrate, phosphate, or chloride from Plaza property points of Brook entry and exit; no decline in dissolved oxygen (DO).

(c) **Water habitat**: Increase in in-stream wildlife indicating relative healthy conditions in the stream habitat by using aquatic insects and other benthic invertebrates.

(d) **Wildlife habitat**: Increase in upland wildlife using the area and moving into adjacent areas.

(e) **Vegetative restoration**: Reduce proportion of invasive species in the corridor.

(f) **Recreation**: Increased use and appreciation of the area by townspeople. Improved pedestrian linkages between neighborhoods, the commercial zone, and UNH campus.

(8) SO, WHAT TO DO?

Specific actions to contribute to stream restoration include work in any of six specific and interrelated components of stream corridor health identified in the stream restoration manual (Appendix B). The Plaza redevelopment is addressing at least (1): land use in surrounding areas. Depending on the extent of the AIA150/ redevelopment scope, work on the Mill Plaza design and implementation also may address: (2) restoration of the stream bank, (3) restoration of the stream channel, (4) in-stream habitat recovery, (5) plant community diversity, and/or (6) habitat enhancement.

As a starting point for consideration by the design teams, Town, and residents, the Work Group identified a range of initial and subsequent actions to consider:

(a) **Initial actions**

(i) Innovative low impact development stormwater management in the uplands to minimize runoff:

- **Work with UNH Stormwater Center and others to identify appropriate innovative design elements for low impact development:** Design to maximize groundwater recharge, minimize surface runoff, control sediment and other pollutants, store snow, and protect a green vegetated link to the Brook for enjoyment by the community. The extent to which these things happen in the redevelopment will greatly influence the success of any restoration work on the Brook itself.

- **Integrate upland stormwater design to maximize recharge in the riparian zone:** Stormwater leaving paved and unpaved surfaces can be directed to riparian areas that will recharge the water table and minimize direct contribution to the stream flow.

(ii) Ecological restoration of the stream corridor—There are a number of restoration steps that can be taken to improve the interrelated functions, services, and benefits College Brook provides, including:

- **Incorporate constructed wetland for flood control, groundwater recharge, and water quality improvement:** A ponded area or constructed wetland could be created where the Brook currently enters the Mill Plaza if the entrance to the Plaza were moved further north up Mill Road toward Main Street. Such an area could store additional floodwater and allow sediment to settle out of the water before it discharges into the main Brook. It could also add aquatic or wetland habitat to the site, though its quality would be limited.

- **Widen Floodplain/Wetland for flood control and water quality:** Maintaining all of the current wetland/floodplain area is important for controlling sediment, nutrients and for storing flood waters. It appears that in the building of the current Mill Plaza, part of the stream channel was moved and adjacent wetland/floodplain was probably filled in by the south edge of the parking lot. This area could be returned to its former topography during redevelopment, adding more flood storage to the system or replacing what was lost years ago. Design for floodplain expansion but protect the large existing trees that serve as a visual and sound barrier for residences across the Brook.

- **Restore vegetated buffers to improve water quality, moderate flood waters, provide wildlife and plant habitats and travel routes, contribute to the scenic quality of the site, and improve protection of the residential neighborhoods from the noise and visual impact of the commercial area:** The publication *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities* recommends a "reasonable minimum" of 100 feet of naturally vegetated land (forested) around wetlands and surface waters to protect water quality. Given the existing conditions, it is unlikely that a 100 foot buffer could be achieved between the Mill Plaza and the Brook. The width of the buffer should be maximized to the extent possible within the current limitations; and other mitigating water management strategies should be in place to compensate for the reduced buffer width.

- **Protect existing vegetated areas in the vicinity:** Protecting existing buffer areas, such as undeveloped areas of current lots adjacent to the Brook on the south side, and between Chesley Drive and the Mill Plaza parking lot, from further development also will help prevent further degradation of the existing buffer.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

- **Replace invasive species to improve habitat for plants and animals:** It was evident on a site visit to the Brook in November, 2007, that the Brook and its associated shorelands provide habitat for animals as well as native plants. The bird life in this area was notably more abundant than in nearby yards and similar areas. The area around the Brook, however, has many exotic invasive plant species mixed with the native ones. It is unlikely, given the extent of invasion, that a native plant community could be established by managing plantings. A trial section of the Brook could be used, however, as a study and demonstration site to show the methods and results of experimental efforts to replace invasive exotic species with natives. Outreach to property owners abutting the corridor to encourage such trials on their in landscaping could help as well.

- **Provide pedestrian paths or pedestrian accessible greenway:** Construct a universally accessible walking path connecting existing paths from Faculty Road and Chesley Drive with the campus and Plaza.

- **Design the site for safe bicycle access/egress and throughflow:** Incorporate safe bicycle and pedestrian flow to, from, and through the Mill Plaza.

(b) Longer term

- **Work with UNH:** Coordinate future continuing work on the Mill Plaza section of the College Brook corridor with UNH plans to improve health of upper watershed. This includes daylighting the Brook through Parking Lot C and renewing plans to restore wet meadow and riparian corridor near the intersection of Main Street and Route 155A (Mast Road).

- **Maintain stormwater management structures:** Maintenance of low impact development stormwater management features such as retention/detention ponds, constructed wetlands, bioretention/rain gardens, and retrofitted swales is important for continued function. The UNH Stormwater Center database and field facility provide many examples of successful projects (http://erg.unh.edu/lid/detail.asp?lidmainidID=122)

- **Continue to replace invasive species to improve habitat for plants and animals:** Build on findings from the initial trial Brook work to continue to replace invasive exotic species with natives.

- **Link Mill Plaza with local history:** Provide historic and natural interpretive signs in the Plaza area, and along path network.

(c) **Measurement and evaluation**:   Report to Town and UNH on status of indicators at least annually.

REPORT TO THE MILL PLAZA STUDY COMMITTEE

(9) **AND, FINDING THE RESOURCES TO MAKE IT HAPPEN**:

(a) Design for multiple benefit by integrating stormwater management into site design to minimize the need for extensive additional stormwater management expenditures.

(b) Work with multiple partners (MPSC/AIA150, UNH departments, UNH Cooperative Extension, Mill Plaza groups, Natural Resources Conservation Service, and NH Department of Environmental Services) to leverage expertise and funding sources.

(c) Seek a variety of funding sources (Federal, state, local, private).

(d) Find opportunities for in-kind donations of professional expertise, research, labor, plant materials, interpretive signs, etc.

(e) Work with UNH to engage student interns, incorporate graduate student research projects, etc.

ACKNOWLEDGEMENTS:

The College Brook Restoration Work Group members (listed in <u>Appendix F</u>) thank the Mill Plaza Study Committee for the opportunity to prepare this report. The report editor, Kate Hartnett thanks the Work Group and AIA150 Core Group members for their timely input and comments, and Durham residents Robin Mower for the Brook tour on 7 Nov and Julian Smith for the copyedits on 27 Nov 2007. This report was produced in the three weeks in between.

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STREAM CORRIDOR RESTORATION
Principles, Processes, and Practices

Federal Interagency Stream Restoration Working Group
10/98 Published Version, Revised 8/2001

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APPENDIX B: STORMWATER MANAGEMENT/ECOLOGICAL RESTORATION CASE STUDY

Bryn Mawr College in Pennsylvania has a couple of success stories to share. The College Director of Grounds, Greg Nichols, led projects to create Rhoads Pond, a stormwater retention and filtration pond, and to naturalize two streambeds on the Graduate School of Social Work campus:

(1) **Innovative Stormwater Management:** After initial scoping, the College received a $150,000 Growing Greener grant from the State of Pennsylvania to support an integrated stormwater management project. The retention/filtration pond is fed by the Lower Merion Township's storm sewers, and filter stormwater from 56 acres (largely not college land). The upper half of the pond serves as a catch basin in which sediment and trash from the Township's storm drains collects. The upper half is separated from the larger retention pond by a wall of gravel-filled cages that serve as a filter. Every four or five years the grounds crew spends several days with a vacuum truck removing truckloads of sediment and trash that would have otherwise gone down Mill Creek and into the Schuylkill and ultimately Delaware Rivers. Greg has ended up using the organic matter to mix in with other soils for plantings around campus. See the College's website:

http://www.brynmawr.edu/facilities/documents/AnInnovativeandCollaborativeApproachtoStormWaterManagement.pdf

for a very detailed 7-page description and analysis of the project, including maps and information about history and execution of the project (*copy of report follows this summary*).

 (2) **Stream restoration**: Subsequently, the College received a $385,000 Growing Greener grant from the State of Pennsylvania to assist with a stream restoration project at the Graduate School of Social Work and Social Research, on nearby Airdale Road, and in the adjoining Township park. The Graduate School's building was originally built as a parochial high school, and the two streams on the property were tightly controlled with stone and masonry walls. The narrow streambeds were not ideal for plant or wildlife as they offered few quiet areas for stream life and storm water was not slowed at all. During major storms the walls were sometimes breached and the school's basement classrooms flooded.

Working with Lower Merion Township and the Lower Merion Conservancy, the College had several hundred feet of stream bed "reconstructed" to a "natural" state. Within a new 15' to 20' wide creek bed, a 5 -6 ' wide meandering stream was created with small dams to create pools and waterfalls to aerate the stream. The wider and relatively straight creek bed was planted with low-growing native shrubs so that as stormwater exceeds the normal stream capacity it is slowed by the shrubs. The roots of these plantings hold the soil banks, and their foliage provides shade for the stream and cover for wildlife. Visitors were delighted to count 10 water snakes residing in the stream area, and the Lower Merion Conservancy has been conducting on-going monitoring to document the growth in diversity from this project.

I understand that a professor at Villanova University, who specializes in storm water management issues, regularly brings classes and conference attendees to view these installations.

28 November 2007

The UNH Stormwater Center

The UNH Stormwater Center studies stormwater-related water quality and quantity issues. One unique feature is the field facility to evaluate and verify the performance of stormwater management devices and technologies. Fifteen different management systems are currently undergoing side-by-side comparison testing under strictly controlled conditions.

This on-campus evaluation facility enables the Center to offer technology demonstrations and workshops, and also specialized training opportunities. In addition to the primary field facility, the Center has other sites available to study approaches that need more space or present unique conditions.

Under new Clean Water Act Phase II rules, the Environmental Protection Agency requires local governments to develop stormwater programs. In response, many organizations have or are now developing plans and actions to achieve desirable water quality and storm volume reduction. Although many of the stormwater management devices are based on sound theory, there is no requirement that they undergo independent, third-party scientific testing. Perhaps as a result, a three-year study of nine seacoast sites in New Hampshire showed that traditional stormwater technologies failed in reducing at least one water quality parameter two-thirds of the time.

UNIVERSITY OF NEW HAMPSHIRE

Mission	• Test stormwater control measures • Disseminate test results and evaluations • Demonstrate innovative stormwater management technologies
Partnering	The Stormwater Center involves a range of participants. Our Technical Advisory Board provides advice and expertise, and includes industry representatives, state and federal regulators, academics, and local government officials. Vendors, manufacturers, regulatory agencies, system designers, and the thousands of entities required to comply with the Clean Water Act benefit from Stormwater Center research. All are encouraged to comment on the facility and testing methods.
Field Facility & Stormwater Control Technologies	The primary field facility is located at two sites on the UNH Durham campus. Stormwater controls currently being tested include: subsurface treatment wetlands, infiltration devices, filtration devices, detention ponds, manufactured devices, a tree box, inlet inserts, and a porous asphalt pavement parking lot. The contributing drainage area is almost completely impervious and generates stormwater flows typical of many developed urban and suburban subcatchments. Planning is underway for site research of non-structural Best Management Practices, such as street vacuuming.
Project Timeline and Outreach	Full site operation began in August 2004. Information is communicated several ways, including technology demonstrations, short courses, an engaging and regularly updated website, publication in refereed journals, and presentations at regional and national forums.
Funding	Funding is provided by the Cooperative Institute for Coastal and Estuarine Environmental Technology and the National Oceanic and Atmospheric Administration. The Stormwater Center is part of the Environmental Research Group at the University of New Hampshire in Durham.
Contact	Dr. Thomas Ballestero, Principle Investigator tom.ballestero@unh.edu (603) 862-1405 Dr. Robert Roseen, Director robert.roseen@unh.edu (603) 862-4024 Gregg Hall, 35 Colovos Road University of New Hampshire Durham, NH 03824-3534 Fax: (603) 862-3957 http://www.unh.edu/erg/cstev

APPENDIX D: TIMELINE OF COLLEGE BROOK HISTORY

1920's	College Brook was the border of UNH. The University didn't build across the brook until after WWII.
1956-58	The Memorial Union Building (MUB) was built adjacent to the brook
1960	Spaulding Life Sciences building construction completed. Building is built across College Brook. Laboratory waste allegedly drains directly into the brook.
	Mill Plaza Land developed for commercial use with a building 1/3 the size of present-day building #1
1968	Plaza was built on 10 acres of land originally owned by the Osgood family and formerly farmed by the Chesley family. Original developers: Tamposi and LeHouillier
1969	Mill Plaza Building #1 opens
1969-70	Extension to MUB built over the ravine
1977	Planning Board approves site plan for a new 24,000 sq. ft. building to the east of Mill Plaza Building #1
1979	Mill Plaza Building #2 built
1995	University opens new biological sciences center (Rudman Hall) and the section of College Brook adjacent to the Rudman site is re-routed through a culvert.

Sources:

Doug Bencks, UNH Architect and Director of Campus Planner – personal communication, Nov 2007

Durham Historic Association - 1970's Scrapbook located at the Durham Historic Association Museum

John Harwood, AICP, planning consultant - memo to Jim Campbell, Durham Director of Planning and Community Development, 2 Oct 2002 (original in Durham's Planning Dept files for the Mill Plaza)

Elizabeth Slomba, UNH archivist - personal communication, November 2007

Julian Smith, Durham Town Council and long-time Durham resident – personal communication, November 2007

University of New Hampshire online archive downloaded on 18 Nov 2007 from:
http://www.izaak.unh.edu/archives/history/chronology/ and
http://www.izaak.unh.edu/archives/history/buildings/

28 November 2007

APPENDIX E: **HISTORICAL PHOTOS**

APPENDIX F: COLLEGE BROOK RESTORATION WORK GROUP MEMBERS

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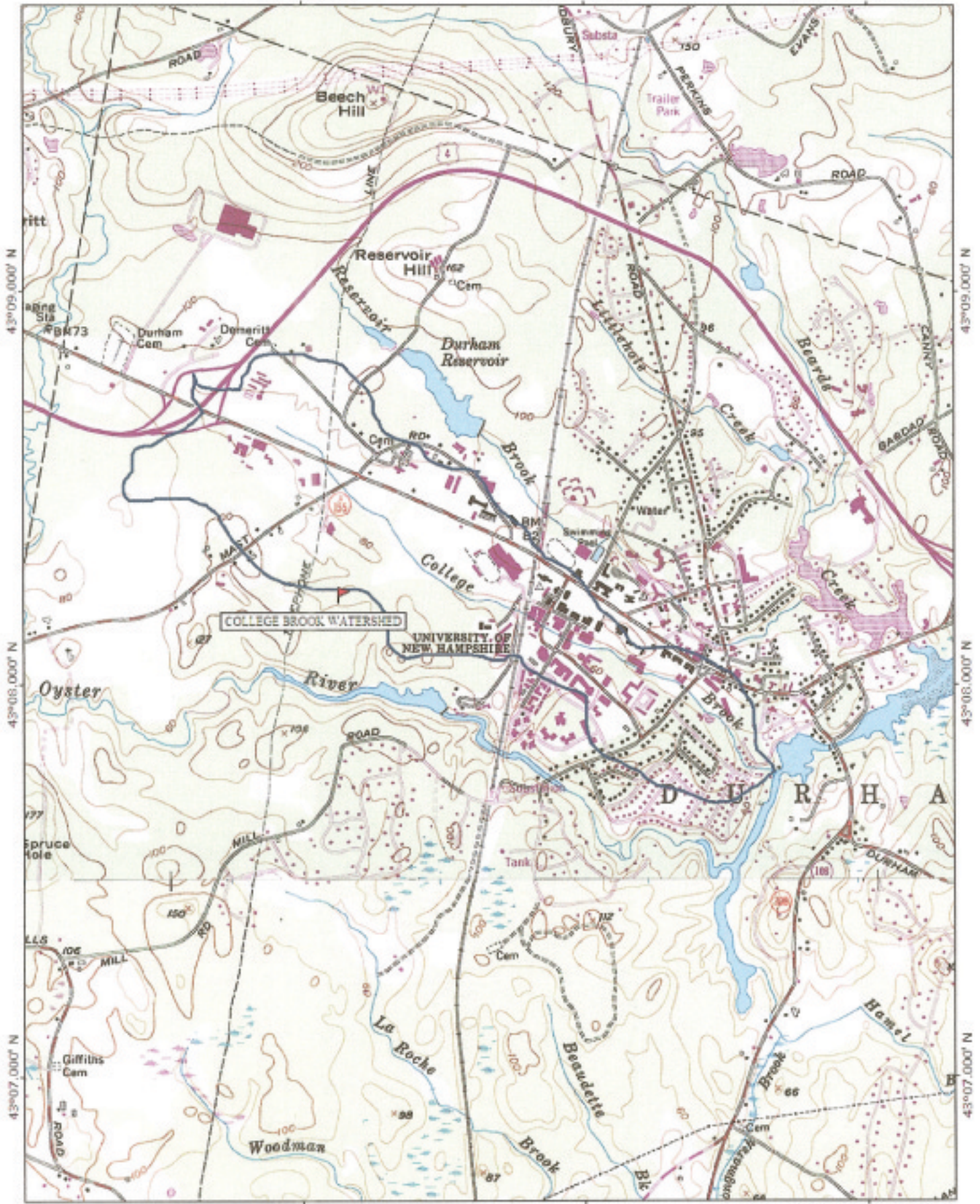
Dan Coons, Hodgson Brook Restoration, Portsmouth, NH (trailrnr@yahoo.com)

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Dick Weyrick, Oyster River Watershed Association (dweyrick@comcast.net)

COLLEGE BROOK WATERSHED

UNIVERSITY OF NEW HAMPSHIRE

Beech Hill

Reservoir Hill

Durham Reservoir

Oyster River

Spruce Hole

DURHA

La Roche

Woodman

Beaudette Brook

USGS **Durham, New Hampshire, United States** 11 Apr 1998

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Image courtesy of the U.S. Geological Survey