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2897.08

November 17, 2023

Board of Water Commissioners
New London-Springfield Water System Precinct
73 Old Dump Road
New London, NH 03257

Re: Surface Supply Investigation – Little Lake Sunapee
Additional Water Supply Capacity Investigation
New London-Springfield Water System Precinct

Dear Commissioners:

As part of ESR #7 – Additional Water Supply Capacity Investigation, Underwood Engineers (UE) scope of work included an evaluation of use of Little Lake Sunapee as a Surface Water Supply source. This scope is summarized below:

- Investigate the feasibility of a drinking water intake into Little Lake Sunapee
- Review available water quality records to determine suitability as a drinking water supply
- If appropriate, consider use of lake as a source of groundwater artificial recharge
- If a drinking water intake is installed, determine required and or desired restrictions around the lake.
- Determine planning level cost

The following letter summarizes our evaluation of the noted scope items.

Feasibility of Little Lake Sunapee as a Surface Water Supply Source

As an alternative or supplement to the groundwater supply, our scope of work included a preliminary investigation into the feasibility of use of Little Lake Sunapee as a direct surface water supply source. Currently, the lake serves as the primary source of recharge to the Colby Point wellfield. Pumping the wells creates a gradient and therefore flow from the lake to the wells and the water is filtered through the intervening aquifer deposits. The varying nature and fineness of these deposits, along with the shallow well depth and limited available drawdown, is limiting the amount that can be pumped from the wells. A direct intake into the lake would eliminate the pumping limitations of the wells, however, direct use of surface water requires significant permitting, potential restrictions, and perhaps most importantly, construction of a water treatment plant with its attendant capital and ongoing O&M costs.

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Permitting Requirements

We contacted NHDES to determine the regulatory requirements for a direct intake into Little Lake Sunapee and specifically, whether a 401 Water Quality Certificate (WQC) would be required. The answer to this question is almost certainly yes since state law requires NHDES to certify that any surface water withdrawal of more than 20,000 gpd will not cause a violation of water quality standards. This is an important consideration given that the process takes time and expense. In a recent project for a river intake for an artificial recharge project, this process took over a year to complete at significant cost.

Based on our contact with NHDES, the following permitting and regulatory requirements are anticipated for an intake into Little Lake Sunapee.

- 401 Water Quality Certificate (WQC)
  - This is required under two separate sources but only one would be required for the project
    - Any withdrawal of more than 20,000 gpd must meet state water quality standards so an application for a WQC is required.
    - An intake would require a wetlands permit under Section 404 of the Clean Water Act which also requires a 401 WQC
- Antidegradation evaluation
  - NHDES determines this as part of the 401 WQC process based on whether there will be an insignificant or significant lowering of water quality due to the withdrawal.
    - If there is an insignificant lowering of water quality, NHDES will grant the 401 WQC along with proper best management practices.
    - If there is a significant lowering of water quality, then an alternative analysis is required per Env-Wq 1708.10 to show that this withdrawal is necessary over other alternatives. In terms of an impact due to the withdrawal, it is noted that a direct intake would simply change the point of withdrawal from the existing wells, not dramatically increase it.
- Wetlands permit
  - Any infrastructure impacting the jurisdictional wetland area of the lake will require a wetlands permit. This could be a general section 404 permit, but given the sensitivity of the lake, it is more likely that a more involved Army Corp of Engineers (ACOE) individual permit will be required.
- Shorelands Water Quality Protection Act (SWQPA) permit
  - Any activity within 250 ft of the "reference line" which in this case is the 1219.85 contour or basically the high-water elevation, requires a SWQPA permit. The goal of the shoreland protection rules are to maintain the natural woodland or vegetative cover in the shoreland protection zone in order to protect water quality. Any permit would include conditions relative to clearing and erosion control.

- Source Water Protection Plan & Conservation Plan
  - Any new source will require development of a Source Water Protection Plan as well as a Conservation Plan if one does not currently exist. There are specific requirements and guidelines for development of these plans contained in the Code of Administrative Rules.
- Infrastructure Approval
  - Any improvements to a Public Water System in NH requires review and approval of the Drinking Water and Groundwater Bureau (DWGB) of NHDES.

Based on our discussions with NHDES, all of these permits or requirements can be achieved. However, there is significant time and expense involved and there is potential for the process to be derailed or delayed such as with the antidegradation review or with added requirements that add unplanned expenses.

Potential Intake Locations Based on Bathymetry and Precinct Access

Figures 1 & 2 are bathymetric maps of Little Lake Sunapee taken respectively from a 1980 *Little Lake Sunapee Watershed, Water Quality Management Investigation* by Howard, Needles, Tammen & Bergendoff (HNTB) and a more recent version downloaded from the NH Fish & Game website.

Morphological features of Little Lake Sunapee from the 1980 HNTB report, as well as some included on the NHF&G website are shown in **Table 1.**

Table 1 – Morphological Features of Little Lake Sunapee

Feature	**Unit**	**1980 HNTB Watershed, Water Quality Management Investigation**			**NHF&G Website**
		Entire Lake	**East Basin**	**West Basin**	**Entire Lake**
Watershed Area	Ac	3558	2779	796	-
Lake Area	Ac	475	234	241	486
Max Depth	Ft	41	41	22	43
Mean Depth	Ft	16.2	17.3	13.7	14
Volume	Ft^3 (Gal)	335×10^6 (2.5×10^9)	176×10^6 1.32×10^9	144×10^6 1.08×10^9	- -
Shoreline length	Mi	5.9	2.5	3.4	-

Figure 1 – Little Lake Sunapee Bathymetry from HNTB Report, 1980

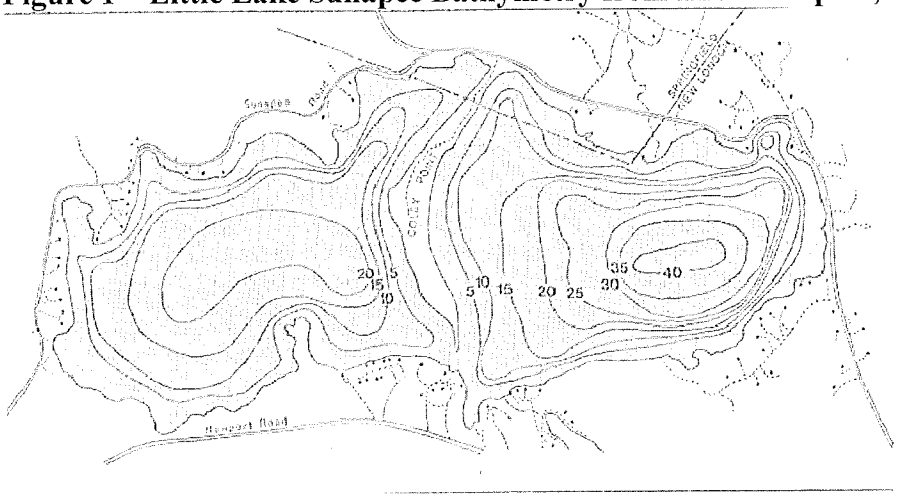
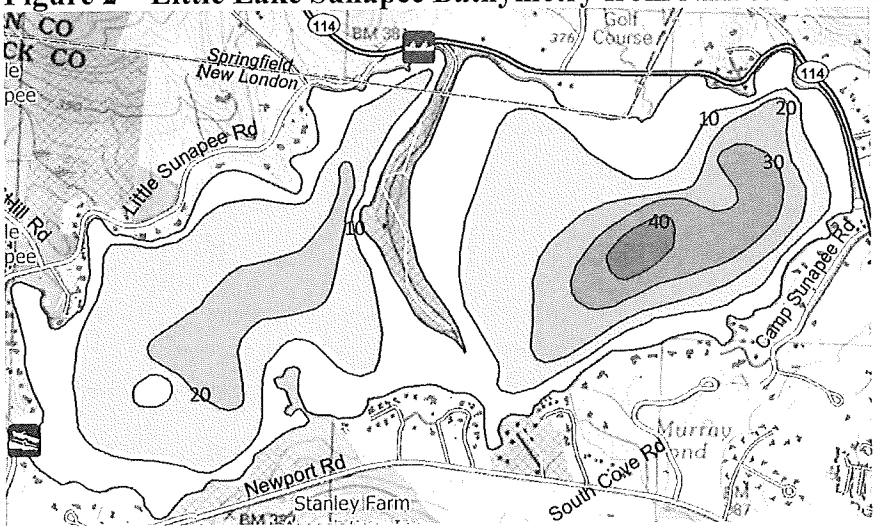


Figure 2 – Little Lake Sunapee Bathymetry from NHF&G Website (Date not given)



The difference between the 1980 data and the more recent NHF&G data is thought to be more a matter of measurement method (hand measured versus computer generated figures) rather than actual changes in the lake area or depth, although it is possible that sedimentation over the 43 years since 1980 may have reduced depth in areas.

The west basin is considerably shallower than the east basin. The shallower depth would limit the depth of an intake and could lead to more water quality and temperature issues. Given this and its greater distance from the existing water system, the west basin was eliminated from consideration for an intake.

Both bathymetric maps show a maximum depth contour of 40 feet in the east basin although the 1980 map shows a greater extent at this depth. This is deep enough to undergo thermal stratification in the summer months wherein there is an upper warmer layer of water called the epilimnion, which is separated from the deeper, colder and slightly denser layer of water known as the hypolimnion. The separation between these layers is called the thermocline due to the change in temperature, and therefore density of the water. This difference in density reduces mixing between the layers while the lake remains stratified, and the hypolimnion does not receive as much oxygen from the surface and becomes more anoxic. This has water quality implications because in an anoxic environment, naturally occurring organics and metals such as manganese are released into the water column from the sediments.

Figure 3 is a temperature and dissolved oxygen profile of the east basin dated July 6, 1979 taken from the 1980 HNTB report. This shows a not-very-well defined thermocline starting at approximately 3 m (9.84 ft) and leveling off to a more consistent colder temperature below 9 m (29.5 ft). Dissolved oxygen shows a similar profile. In terms of depth for an intake, it must be deep enough to ensure it always has sufficient water above it, not cause a navigational hazard, but not be so far into the hypolimnion as to cause water quality issues during stratification. Some systems with lake sources have intakes with openings at different depths which can be changed seasonally. More recent data would be needed to finalize an intake depth but based on Figure 3, a depth between 20 and 30 feet would be appropriate.

The Precinct has no direct access to either basin of Little Lake Sunapee. There is an easement for the Colby Point Wellfield and transmission main but this does not provide access to the lake. The existing pump station site is across Route 114 from the lake and is very limited. The Precinct office is relatively close to the lake but again provides no access. However, the Town of New London owns land both on the lake where Bucklin Beach is located, and immediately adjacent to the Precinct lot where the old dump was located. In order to come up with a very preliminary conceptual project incorporating an intake into the east basin of Little Lake Sunapee, we assumed the following:

- The Precinct and Town of New London would partner to install an intake such that the raw water main would pass below Bucklin Beach and extend about 1,000 feet into the lake to around the 30 foot depth contour. The beach would be completely restored with no visible infrastructure.
- The raw water main would pass below Town lot 033-009 to reach Old Dump Road, avoiding private property.
- The Precinct would work with the Town to site a new Water Treatment Plant on Town lot 033-035 (former dump), adjacent to the Precinct lot as the latter is too small to site such a facility.

This conceptual plan is shown in **Figure 4.**

Figure 3 – Temperature & Dissolved Oxygen Profile – Little Lake Sunapee East Basin (from HNTB, 1980)

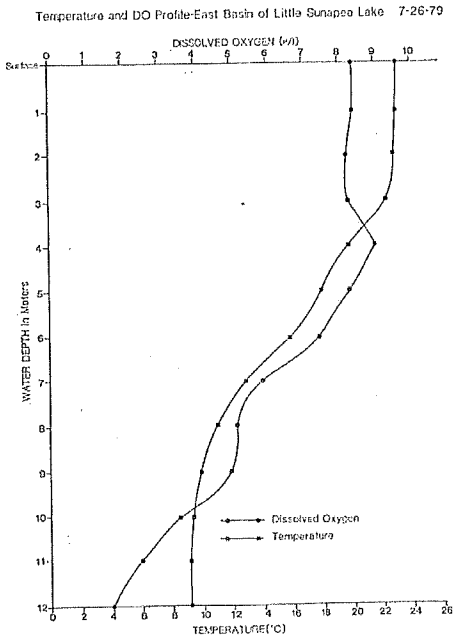
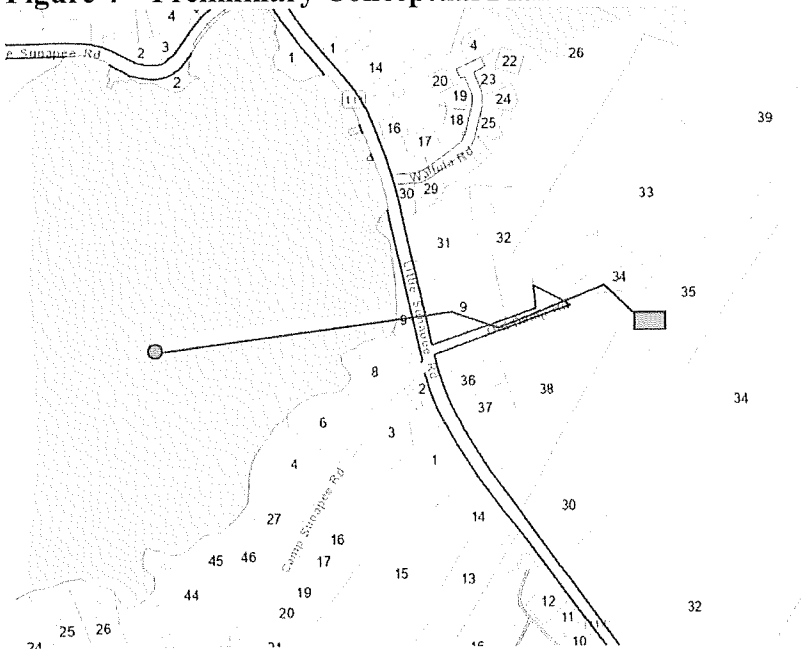


Figure 4 – Preliminary Conceptual Plan – Little Lake Sunapee Intake and WTP



Little Lake Sunapee Water Quality

Because the lake is not a water supply source, other than as a recharge source for the Colby Point wells, there are few water quality records we could find that have typical drinking water quality parameters. However, a study was conducted in 1980 (Little Lake Sunapee Watershed Water Quality Investigation, HNTB) in which typical lake assessment water quality data was taken to determine the lakes trophic status which is a measure of the biological productivity. There are three trophic states as noted below:

- Oligotrophic – deep, clear, low amount of nutrients, produce little organic matter in the form of algae…the cleanest of the three states.
- Eutrophic – higher nutrient levels, more algae due to more organics, less clear, potential for chemical and physical conditions not desirable for water supply…the least clean of the three states
- Mesotrophic – lakes that are somewhere on the gradient between oligotrophic (best) and eutrophic (worst)

Data from Little Sunapee was compared to data from three other NH lakes respectively labelled as oligotrophic (Newfound Lake), mesotrophic (Webster Lake) and eutrophic (Kezar Lake). Based on this comparison, as shown in **Table 2,** Little Lake Sunapee was designated as oligotrophic, which is the best trophic state for a water supply.

Table 2 – Little Lake Sunapee Trophic Status & Water Quality - 1980

Parameter	Units	Little Lake Sunapee[1]	Newfound Lake (Oligo-)[1]	Webster Lake (Meso-)[1]	Kezar Lake (Eu-)[1]
Alkalinity	mg/L	3.9	4	5.5	7.0
Chlorophyll-a	µg/L	2.27	2.61	3.99	52.35
Conductivity	µS/cm	-	-	-	-
Chloride	mg/L	-	-	-	-
Total P	µg/L	<2	6	14	30
Transp. (secchi disc)	m	5.5	11.3	3	<1
Nitrate	mg/L	0.05	<0.05	<0.05	<0/05
pH	SU	6.2	7	6.4	8.3
Color	PCU				
Turbidity	NTU				

Notes
[1] Little Sunapee Lake Watershed Water Quality Investigation, HNTB (1980)

The Volunteer Lake Assessment Program (VLAP) is a partnership between NHDES and lake residents to monitor the water quality of their particular lake. NHDES compiles and analyzes the data in an annual VLAP report for each lake in the program. While Little Lake Sunapee is not in the program as a separate entity, it is in a sub-watershed of Lake Sunapee, which is in the VLAP program. There are four stations monitored annually, three where the quality of water entering the lake is monitored and one at the outlet of the lake. Data from the 2020 VLAP Annual Report on Lake Sunapee Tributaries is shown in **Table 3.** Based on the 2020 and earlier data, NHDES still labels Little Lake Sunapee as oligotrophic, but impacts over the 40 years since the 1980 assessment

can be seen. Total phosphorus seems to be higher in the lake and several of the tributaries to the lake are contributing elevated levels of chloride, color and turbidity. The outlet sample shows how the elevated inputs are dampened with cleaner recharge and residence time in the lake.

Table 3 – 2020 Average Water Quality Data – Little Lake Sunapee Sub-Watershed

Parameter	Units	NH Median Values[2]	Kidder Brook Upstream[2] (1410.5)	Bucklin Beach Brook[2] (1415)	Murray Pond Outlet[2] (1418)	Little Lake Sunapee Outlet[2] (1420)
Alkalinity	mg/L	4.5	-	-	-	-
Chloraphyll-a	µg/L	4.39	-	-	-	-
Transp (secchi)	m	3.3	-	-	-	-
Conductivity	µS/cm	42.0	20.7	514.8	581.7	87.2
Chloride	mg/L	5	3	125	173	21
Total P	µg/L	11	12	26	22	8
pH	SU	6.6	6.78	6.82	6.41	6.72
Color	PCU	-	73	172	273	30
Turbidity	NTU	-	1.34	5.58	1.03	1.38

Notes
[2] VLAP Annual Lake Report: Lake Sunapee (Tributaries) (2020)

Table 4 – Summary of Water Quality Results in Lake Sunapee Watershed

Table 9 - Summary of Water Sample Results for Selected Biological and Chemical Parameters for Waterbodies in the Lake Sunapee Watershed (Source: NHDES 2017).

Waterbody	Phosphorus	Chlorophyll-*a*	Transparency	Conductivity	pH and Alkalinity	Dissolved Oxygen - Hypolimnion
Dutchman Pond	Mesotrophic conditions - but trending towards oligotrophic.	Not significantly changed, below threshold for oligotrophic lakes. Historical data show the average is less than the state median and variable.	Very good but decreasing over time.	Stable and low.	Slightly acidic, lower than desired range.	Insufficient data to assess.
Little Lake Sunapee	Oligotrophic conditions in the epilimnion and mesotrophic conditions in the hypolimnion, variable P.	Low but variable. Stable over time.	Transparency decreasing over time.	Greater than the state median, stable but variable.	Slightly acidic, note higher acidity in the hypolimnion.	Lower in metalimnion and hypolimnion than the epilimnion – potential for future internal phosphorus loading.
Mountainview Lake	Mesotrophic conditions - not significantly changed, P concentrations slightly less than state median.	Not significantly changing, historical data show the average is approximately equal to state median.	Transparency decreasing over time.	Greater than the state median, highly variable.	Slightly acidic note pH decreasing over time.	Much lower in hypoliminion – potential for future internal phosphorus loading.
Otter Pond	Mesotrophic range and stable over time.	Lower than state median but increasing over time.	Transparency decreasing over time.	Above state median and increasing.	Generally within desired range but epilimnetic values occasionally low. Decreasing over time.	Much lower in hypoliminlon – potential for future internal phosphorus loading.

Table 4 was taken from the 2020 Lake Sunapee Management Plan. Based on the data, NHDES considers the epilimnion of Little Lake Sunapee to be oligotrophic but the hypolimnion is now considered to be mesotrophic, a reduction in water quality from past assessments. Transparency has decreased over time indicating an increase in color, organics and turbidity. The comment on potential internal phosphorus loading indicates that the potential for algal blooms exists.

Based on our evaluation, even with some water quality degradation over the last 40 years, Little Lake Sunapee remains a high-quality source and has acceptable water quality for use as a drinking water supply. It would of course need to be treated for compliance with the Surface Water Treatment Rule and to meet all Safe Drinking Water Act water quality parameters.

Potential for Artificial Recharge of Groundwater Supply Using Little Lake Sunapee

Artificial Recharge (AR) involves pumping water from a surface water source and applying it to an aquifer both for later use and as an augmentation of natural recharge. This is especially useful for aquifers that may have high transmissivity (ability of groundwater to move through aquifer) but limited recharge. It has been used in both Durham and Dover, NH to augment groundwater supplies in sand and gravel aquifers. With sand and gravel aquifers that do not have overlying layers of fine materials, AR can be applied through simple basins such that the water infiltrates to and is stored in the aquifer. If the aquifer is confined or has overlying fine layers, AR may have to be injected which complicates the process.

Consideration was given to use of AR both for the Colby Point Wellfield and/or any potential sand and gravel supplies identified by GZA as part of this study.

Per GZA, AR would not provide any benefit for the Colby Point wellfield. Since the point is surrounded by the lake, availability of recharge is not the issue for these wells, but rather the fine and variable deposits that the wells are sited in. Additionally, due to layers of fines, AR would have to be injected as opposed to using recharge basins. Therefore, AR is not recommended for the Colby Point wellfield.

GZA's investigation concluded that there are no other sufficient sand and gravel deposits within a reasonable distance of the NLSWSP system that are suitable for a well that would benefit from AR. It was therefore dropped from further consideration.

Surface Water Intake Restrictions

Our scope of work noted we would determine "required and/or desired restrictions" around a potential intake into Little Lake Sunapee. There is a big difference between required and desired restrictions. There are no required restriction areas or use activity restrictions by NHDES for surface water intakes. This is up to the local entity, be it a town or water utility. All surface drinking water intake restrictions in NH have been established voluntarily through a process described in statute in *RSA Section 485:23 – Petition to Protect Water Supplies*. This petition is made to NHDES who then works with the petitioner to establish restrictions that will protect water quality and meet the needs of the local entity. These are then added as an administrative rule in

Env-Dw 902 which contains all the restrictions for each system and makes them enforceable by NHDES. Study of Env-Dw 902 as well as the list of surface water suppliers in the state indicates that there are about 36 large systems using surface water supplies. Of these, 27 have restriction zones and/or use restrictions associated with the intake that are contained in Env-Dw 902. The majority of the systems with no Env-Dw 902 restrictions have river intakes. A copy of both Env-Dw 902 and a NHDES Fact Sheet (DWGB 13-2) of Large Surface Water Treatment Plants in NH are attached to this letter.

In a meeting with NHDES Source Water Protection officials, it was acknowledged that there are no required restrictions and that if NLSWSP were to establish an intake and surface water treatment facility, NHDES cannot force any restrictions. However, they would strongly recommend actions to protect water quality and would be monitoring conditions to see if some sort of restrictions may be necessary going forward.

Planning Level Cost

We assigned planning level costs to each major facet of a new surface water system consisting of an intake into Little Lake Sunapee, a new Water Treatment Plant and connecting water main (**Table 5**). It is stressed that these are order of magnitude costs without benefit of preliminary or even conceptual design. These costs do not include purchase of land or any easement costs.

Table 5 – Planning Level Cost for New Surface Water Intake and Water Treatment Plant

Item	Planning Level Cost
Permitting	$100,000
Intake	$300,000
Raw water pipeline	$600,000
Water Treatment Plant	$15,000,000
Subtotal	$16,000,000
Engineering (25% of Construction)	$4,000,000
Contingency (20% of Construction)	$3,200,000
Total Project	$23,200,000

Conclusions

It would be feasible to install an intake into Little Lake Sunapee. The water quality is very good and acceptable as a raw water source for a drinking water supply. The water would require treatment, however, to meet Surface Water Treatment Rule requirements. Access to the Lake and siting a Water Treatment Plant would require either purchase of land and/or easements with the Town of New London. While restrictions are not required for drinking water surface water intakes, almost every non-river surface water system in the state has restrictions of some sort. If Little Lake Sunapee were to be used as a drinking water supply, NHDES would monitor source water quality and could recommend or suggest restrictions in the future. Constructing and operating a surface water intake and Water Treatment Plant would be a very expensive option and should be compared to any feasible groundwater alternatives.

We hope that the above summary meets your needs as it relates to the surface supply option of this project. If you have any questions, please do not hesitate to call.

Very truly yours,

UNDERWOOD ENGINEERS

For Michael B. Metcalf, P.E. (NH)
Senior Project Manager

MBM/
Enclosure

cc: Rob Thorp, Superintendent (w/ encl.)
Peter Pitsas, UE (w/ encl.)